Appendix 6.8-A

Terrestrial Wildlife and Vegetation Baseline Report

AJAX PROJECT

Environmental Assessment Certificate Application / Environmental Impact Statement for a Comprehensive Study

Ajax Mine

Terrestrial Wildlife and Vegetation Baseline Report

Prepared for

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DISCLAIMER

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EXECUTIVE SUMMARY

Baseline wildlife and habitat surveys were initiated in 2007 to support a future impact assessment for the redevelopment of two existing, but currently inactive, open pit mines southwest of Kamloops. Detailed Project plans were not available at that time, so the general areas of activity were buffered to define a study area. The two general Project areas at the time were New Afton, an open pit just south of Highway 1, and Ajax, east of Jacko Lake. Standard Terrestrial Ecosystem Mapping (TEM) was completed at 1:20,000 for that study area, including field-truthing during the summer of 2007.

A preliminary list of VCs (Valued Components) and indicator taxa was prepared based on at-risk taxa for the area, taxa of regional and Aboriginal Groups concern, and taxa likely to interact with the Project based upon their life history and geographical range. Wildlife surveys for particular indicators were planned when significant data gaps existed. These baseline wildlife surveys were used to document the presence and distribution of target taxa in the study area. Wildlife surveys conducted during the 2007 and 2008 field seasons included breeding bird surveys, woodpecker surveys, bat detector surveys, waterfowl surveys, small mammal trapping, amphibian surveys, snake hibernacula surveys, owl call playback surveys and rare plant surveys. Notable results included the detections of a number of federally and provincially listed wildlife and plant taxa.

Exploration and planning for the Project continued and study areas were periodically revised. The New Afton development area was removed from the area under consideration. The Project's control was passed to KGHM Ajax Mining Inc. (KAM) released more detailed plans, including revised draft footprint areas in early 2010. Some of the revised footprints for the Ajax Project were outside of the previously mapped area, so additional TEM mapping was completed to incorporate those areas. The federal and provincial status of some wildlife and plant taxa had been revised, so the preliminary VC and indicators list prepared in 2007 was updated in 2012. Additional wildlife and vegetation surveys were completed to ensure coverage of the new footprints. Baseline studies were also guided by the requirements defined in the Project Application Information Requirements (AIR), along with input from government, First Nations, and other stakeholders.

Additional changes to the footprints were made and the Project General Arrangement were released by KAM in August 2014. The ecosystem mapping prepared for the Project was used to produce suitability maps for some of the indicator taxa. Suitability maps, field survey results and review of existing information were used to produce this baseline report to support the Project's Environmental Assessment.

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Abbreviations and Acronyms

BC CDC	BC Conservation Data Centre
BEC	Biogeoclimatic Ecosystem Classification
BC MOE	BC Ministry of Environment
BCMFLNRO	BC Ministry of Forest, Lands and Natural Resource Operations
BCWA	BC Wildlife Act
BCMWLAP	BC Ministry of Water, Land and Air Protection
BGC	Biogeoclimatic
BMPs	Best Management Practices
CEAA	Canadian Environmental Assessment Agency
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
DEM	Digital Elevation Model
EA	Environmental Assessment
EAO	Environmental Assessment Office
ECAR	Ecological Community at Risk
ESF	Explosives Storage Facility
FRPA	Forests and Range Practices Act
GCC	Grasslands Conservation Council
GIF	Ground Inspection Form
GWM	General Wildlife Measures
KAM	KGHM Ajax Mining Inc.
LRMP	Land and Resource Management Plan
LSA	Local Study Area
MBCA	Migratory Bird Convention Act
MRSF	Mine Rock Storage Facility
OP	Open Pit
OSP	Ore Stockpile
Project	Ajax Project
RIC	Resources Inventory Committee
RISC	Resource Information Standards Committee
RSA	Regional Study Area
SARA	Species at Risk Act
SR	Service Road
TEM	Terrestrial Ecosystem Mapping
THB	Thompson Basin Ecosection
TIPS	Targeted Invasive Plant Solutions
TRIM	Terrain Resource Information Managment
TSF	Tailings Storage Facility
UWR	Ungulate Winter Range
VCs	Valued Components
VRI	Vegetation Resurce Inventory
WHA	Wildlife Habitat Area
WL	Waterline

1.0 INTRODUCTION

Keystone Wildlife Research Ltd. (Keystone) was contracted by KGHM Ajax Mining Inc. (KAM) to complete baseline terrestrial wildlife and vegetation studies to facilitate an Environmental Assessment (EA) for the Ajax Project ('the Project'). The steps to achieve these objectives included:

- Identification of Valued Components (VCs) for the Project;
- Completing ecosystem mapping;
- Completing wildlife habitat suitability mapping;
- Conducting surveys for selected VCs; and
- Identifying Project effects, mitigation measures and residual effects.

This report describes the existing terrestrial wildlife and vegetation baseline conditions in the vicinity of the Project. It includes the steps involved in identifying Project VCs and describes the methodology and results of field surveys for terrestrial wildlife and vegetation.

2.0 PROJECT SETTING

KGHM Ajax Mining Inc. proposes to develop the Ajax Project (Project), an open pit copper-gold mine at the historic Afton Mining Camp, south of the City of Kamloops, British Columbia (BC). The Project is located in the South-Central Interior of British Columbia, southeast of the junction of the Trans-Canada Highway No. 1 and the Coquihalla Highway (No. 5), within the Thompson Nicola Regional District.

The Project lies in the traditional territory of the Secwepemc Nation. Within the Secwepemc Nation, the Tk'emlúps te Secwepemc and the Skeetchestn Indian Band are the Aboriginal groups in closest proximity to the Project. In a cooperative effort, the Tk'emlúps te Secwepemc and Skeetchestn Indian Bands have formed the Stk'emlupsemc te Secwepemc Nation (SSN), as a division of the greater Secwepemc Nation. The Ashcroft Indian Band and Lower Nicola Indian Band, whose members are part of the Nlaka'pamux Nation also assert their Aboriginal rights to the Project area-an area of common interest with the SSN.

The Ajax property includes two historic pits: the Ajax West Pit, and the Ajax East Pit. Both pits were formerly mined in the 1980s and 1990s. As many as 25 rock types have been recognized in the Project area, some of which are "hybrid" units resulting from the intermixing of multiple rock types.

Key Project facilities include the Tailings Storage Facility (TSF), which is planned as a conventional tailings storage facility; water management ponds; Peterson Creek diversion, and the Tailings Embankments, which will be constructed using mine rock; and four mine rock storage facilities (MRSFs). The four MRSFs include:

- the South Mine Rock Storage Facility (South MRSF),
- East Mine Rock Storage Facility (East MRSF),
- West Mine Rock Storage Facility (West MRSF), and

- the In-Pit Mine Rock Storage Facility (IPMRSF).

Several facilities that will be part of the operation phase but not remain after project closure include the:

- plant facilities and administration buildings,
- reclamation stockpiles,
- explosives facility,
- truck stop and fuel storage,
- power lines, and
- access roads.

The mine plan for the Project predicts an operation based on a mill throughput of 65,000 tonnes of ore per day from the Ajax Pit with up to a 23 year mine life. The construction phase of the Project will be approximately two and a half years, and following the 23 year operation the decommissioning and closure phase is expected to take up to 5 years. Over the mine life the Project will produce approximately 140 million pounds of copper and 130,000 ounces of gold annually with the concentrate shipped by truck to the Port of Vancouver.

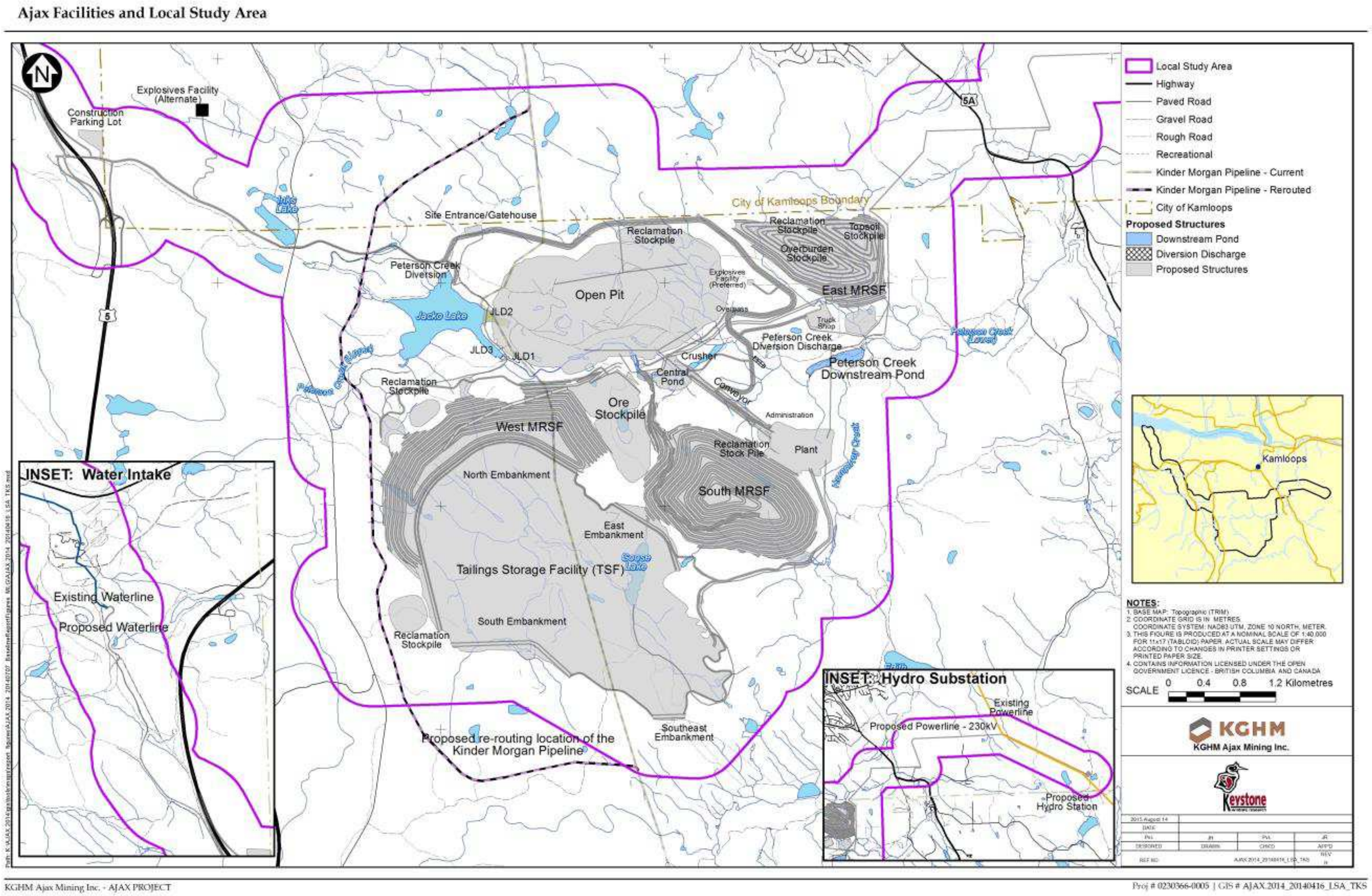


Figure 2-1 Facilities and Local Study Area of the Ajax Project

3.0 APPROACH

3.1 Baseline Reporting

The baseline (current conditions) in the Local Study Area (LSA) was assessed using ecosystem mapping and field surveys targeted at particular VCs. Terrestrial Ecosystem Mapping (TEM) is a provincial standard mapping method (Resources Inventory Committee (RIC) 1998a; Resource Information Standards Committee 2004; BC Ministry of Forests and Range and BC Ministry of Environment Lands and Parks 2010) used to delineate ecosystems on the landscape.

Existing information on terrestrial wildlife and vegetation in the vicinity of the Project was gathered from on-line databases, websites and publications available from provincial and federal sources as well as First Nations and conservation groups (e. g. First Nations Health Council no date; Howie 2004; Rescan Environmental Services Ltd 2006; Iredale & Ferguson 2007; Grasslands Conservation Council of BC 2009; Meads 2011; Environment Canada 2012, 2013, 2014a, 2014b; BC Conservation Data Centre 2013a, 2014a, 2014a; BC Breeding Bird Atlas 2014) and from communications with provincial Ministry staff, Aboriginal groups and the public.

The quantity and suitability of habitat for some wildlife Valued Components (VCs) were assessed using habitat suitability mapping based on the TEM, and created using provincial standard methods (Resources Inventory Committee (RIC) 1999a). Wildlife indicator species for potential VCs were chosen for wildlife habitat suitability modelling based on a combination of their likelihood of being present close to footprint areas, the likelihood of their interaction with the Project, their perceived vulnerability to impacts of mine development, the amount of data available on habitat use, and whether their biology and habitats made them suitable candidates for TEM-based suitability mapping. Draft wildlife habitat ratings were prepared based upon the species accounts and the list of ecosystems mapped. Some field-truthing of the ratings was done during wildlife surveys.

Ratings were run on the TEM mapping and used to prepare habitat suitability maps for each selected VC. Ratings for individual polygons that were field-truthed were adjusted by hand to reflect the suitability recorded in the field.

Field surveys were completed for particular VCs using standard provincial methodologies described within inventory manuals published by the provincial Resource Information Standards Committee. Field surveys were generally done at the present-not detected level and were intended to assess the presence of VCs and their habitats within and outside of the Project footprint, field-truth habitat ratings, and confirm species-habitat associations.

3.2 Issues Identification and Scoping

Issues identification and scoping describes the process by which local issues and values are identified and assessed for their potential to interact with the Project. Issues scoping for terrestrial wildlife and vegetation was done by (BC Environmental Assessment Office 2013):

- documenting the physical and ecological characteristics of the Project’s setting;
- reviewing the Project description;

- reviewing available information on local and regional area;
- review the AIR and other guidance materials provided by EAO;
- consulting provincial review agencies, federal agencies and local governments;
- consulting potentially affected Aboriginal groups;
- consulting key stakeholders such as landowners and community groups; and
- using professional judgment and the expertise of discipline specialists.

3.3 Selection of Valued Components, Key Indicators and Measurable Parameters

Valued Components (VCs) are defined as "components of the natural and human environment that are considered by the proponent, public, Aboriginal groups, scientists and other technical specialists, and government agencies involved in the assessment process to have scientific, ecological, economic, social, cultural, archaeological, historical, or other importance" (BC Environmental Assessment Office 2013). A 'taxon' (plural = 'taxa') is defined for the purposes of this report as named species and subspecies. For terrestrial wildlife and vegetation, VCs may include terrestrial wildlife taxa, vegetation taxa, taxa at risk, and ecological communities at risk.

Suitable VCs are (BC Environmental Assessment Office 2013):

- Relevant and clearly linked to the values reflected in the issues raised in respect of the project.
- Comprehensive, so that taken together, the VCs selected for an assessment should enable a full understanding of the important potential effects of the project
- Representative of the important features of the natural and human environment likely to be affected by the project.
- Responsive to the potential effects of the project.
- Concise, so that the nature of the project-VC interaction and the resulting effect pathway can be clearly articulated and understood, and redundant analysis is avoided.

The list of candidate VCs is generally prioritized towards those that are present in the Project area, have the potential to interact with and negatively affected by the Project, are protected by legislation, are of management priority (e.g. species at risk), are of particular concern to Aboriginal groups, government or the public, and/or are thought to be particularly sensitive or vulnerable to the effects of the Project (BC Environmental Assessment Office 2013). Further refinement of the potential VC list is undertaken to minimize redundancy and maximize effectiveness, focusing on those for which there is sufficient baseline knowledge to permit Project effects to be effectively assessed, and that are not already essentially covered off by another VC. Fewer, well-chosen VCs are preferable to a larger and less efficient group. Where broad taxonomic groups are chosen as VCs (e.g. 'amphibians'), "indicator" taxa (e.g. spadefoot) are often used to provide measurable data on which to assess the effects of the Project.

Species/ecological communities at risk in BC are placed on provincial lists according to their degree of endangerment. The Red List includes "*ecological communities, and indigenous species and subspecies* *that are extirpated, endangered or threatened in British Columbia. Red-listed species and sub-species have- or are candidates for- official Extirpated, Endangered or Threatened Status in BC. Not all Red-listed taxa will necessarily become formally designated. Placing taxa on these lists flags them as being at risk and requiring investigation*" (Province of British Columbia 2011). The Blue List includes "*ecological communities, and indigenous species and subspecies of special concern (formerly vulnerable) in British Columbia*" (Province of British Columbia 2011). Taxa that are not considered at risk are placed on the Yellow List. Taxa may be transferred from one list to another list either because of an actual change in their ecological circumstance (change in risk), or because new data become available on their range, taxonomy, population trend or numbers to justify a change in status. The latter situation is especially relevant for taxa that have been little surveyed and for which even basic life history information may be sparse.

Species may also be listed federally on Schedules 1, 2 or 3 of the *Species at Risk Act* (SARA). Taxa designated as 'at risk' in Canada are placed on Schedule 1. Taxa that were designated as 'at risk' by COSEWIC (the Committee on the Status of Endangered Wildlife in Canada) before the creation of SARA must be reassessed according to the new criteria of the Act before they can be listed on Schedule 1. Those taxa are included on Schedules 2 and 3, and are not yet officially protected under SARA.

Preparation of the list of Project VCs was done using information from a variety of sources, including:

- Lists of Red and Blue-listed wildlife and plant taxa occurring within the Kamloops Forest District and Thompson Basin ecosection as provided by the BC Conservation Data Centre (BC Conservation Data Centre 2014a);
- Information on SARA-listed taxa provided by the Government of Canada (Government of Canada 2008);
- Information on location records of Red or Blue-listed taxa in or near the study area (provided by the BC Conservation Data Centre);
- Information on traditional use of species at the Ajax site (Ignace 2014);
- Data from surveys conducted for the New Gold Project northwest of the Ajax Open Pit, reported by others (Rescan Environmental Services Ltd 2006);
- Data from targeted wildlife surveys and from incidental observations; and
- Information received during the public review process, including First Nations.

3.4 Local Study Area

Two different study areas are generally used in Environmental Assessments. The Local Study Area (LSA) is generally used to evaluate Project-specific (residual) effects. The Regional Study Area (RSA) is a larger area generally used to assess cumulative effects. Characteristics of the Study Areas are described below.

The LSA (**Figure 2-1**) includes the Infrastructure Disturbance Area (IDA) – as provided by the Proponent - buffered by 500 m and is 7,167 ha in size.. All habitats within the IDA polygon are considered to have the potential to be disturbed by the Project. The use of a single polygon rather than individual infrastructure footprints results in an overestimation of the amount of habitat disturbed by the Project. The advantage of the single polygon approach is that it enables individual footprints to be moved about and/or resized within the polygon so minor Project design changes can be easily accommodated without requiring recalculation of the amount of habitat affected.

The RSA includes portions of the South Kamloops Landscape Unit and the Campbell Landscape Unit, including areas south of the Thompson River and west of Highway 97. The RSA is within the Thompson Basin Ecosection, which is a warm and exceptionally dry, broad low elevation basin. The vegetation in this ecosection reflects the warm, dry climate with the Bunchgrass zone mainly consisting of sagebrush-steppe and bunchgrass-steppe occupying the valley and lower slopes, giving way to meadow-steppe and finally to Ponderosa Pine forest, at higher elevations, Douglas-fir occurs on the cooler aspects and narrow draws. The pine stands have been adversely affected by the recent mountain pine beetle outbreak. The forests of the provide numerous natural resource values, including forest products, minerals, fish, wildlife, and recreation and tourism opportunities. Extensive grassland and forested areas provide forage for both livestock and wildlife.

Constraints

The LSA lies within the Kamloops Forest District, in the Thompson Okanagan Natural Resource Operations Region and Ministry of Environment Region 3 (Thompson). Much of it is within the Agricultural Land Reserve. Two landscape units are present, the South Kamloops Landscape Unit in the northwestern portion, and the Campbell Landscape Unit around Jacko Lake. Old Growth Management Areas are present in the LSA. The LSA lies within the area covered by the Kamloops Land and Resource Management Plan (LRMP). Critical deer winter range was identified by the LRMP within the western portion of the LSA (Kamloops Interagency Management Committee 1995), and much of the grassland habitat around the Project is located within a Visually Sensitive Area. There are no Wildlife Habitat Areas, parks or protected areas in the LSA (**Figure 3-1**).

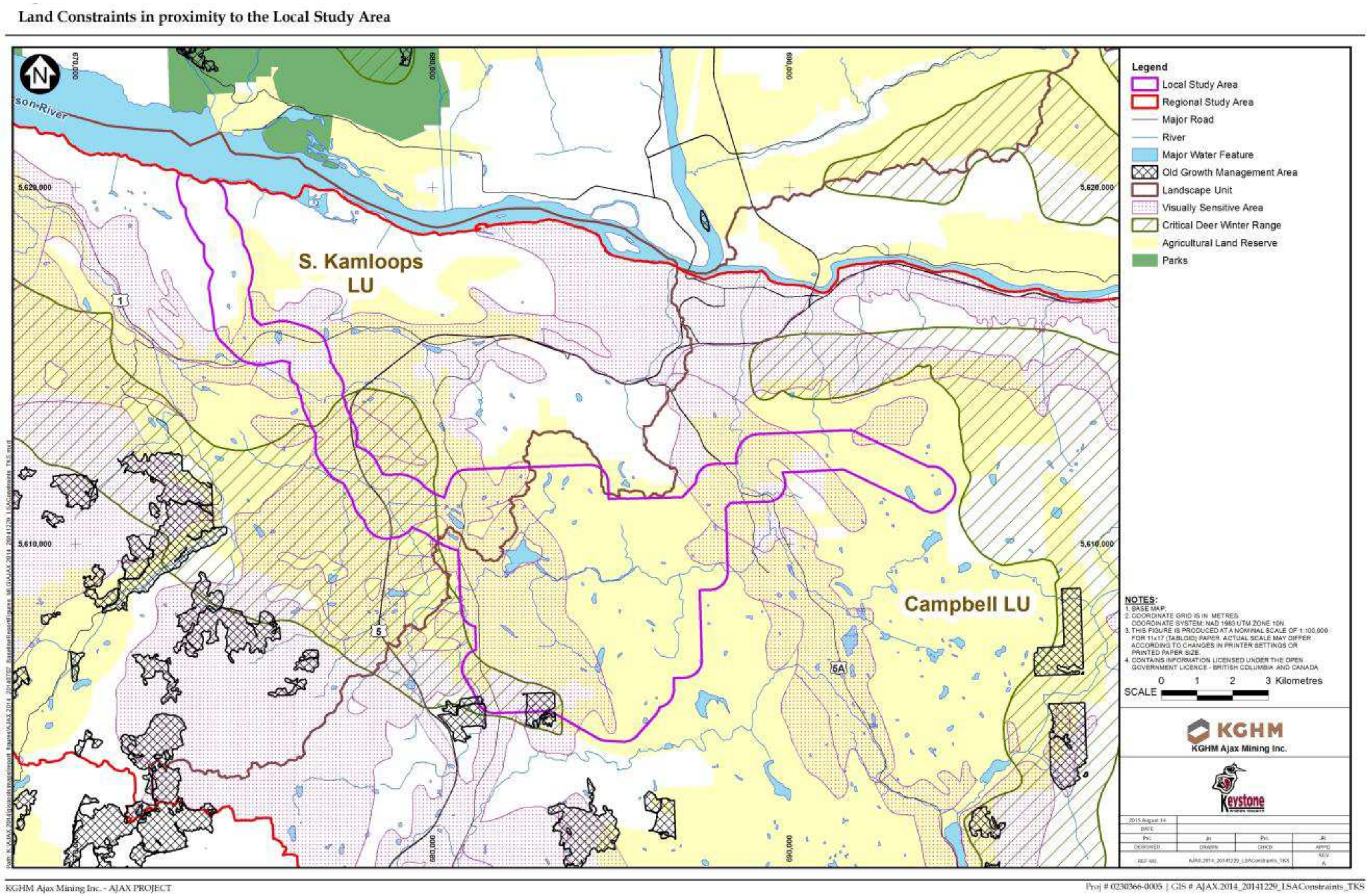


Figure 3-1 Land Constraints in Proximity to the Local Study Area

3.5 Concerns Identified During Aboriginal Groups Consultation and Stakeholder Engagement

Wildlife and vegetation concerns that were raised during the public consultation program include:

- Loss of grasslands and the effectiveness of grassland reclamation;
- Effects on Burrowing Owls and their habitat;
- Effects on ungulates (primarily wintering deer);
- Effects on amphibians and amphibian migration and dispersal;
- Effects of the relocation of Peterson Creek on aquatic wildlife, including beaver and waterfowl;
- Effects of habitat loss and visual and auditory disturbance on migratory birds using Jacko Lake and other waterbodies; and
- Effects on rare plants and traditionally-used plants (Appendix 8).

Wildlife and vegetation concerns that were raised during consultation with First Nations groups included:

- Effects on species that are hunted or have traditional value from habitat loss, disturbance, or displacement as a result of mining activities, noise, light, or dust;
- Effects on berries, roots and medicinal/ceremonial plants that are traditionally gathered; and
- Effects on grasslands and ecological diversity.

These concerns were considered when selecting VCs and indicator species and will be addressed within the impact assessment reports associated with the specific VC.

3.6 Valued Component, Key Indicators and Measurable Parameters

VCs chosen for the Project include:

- Rare Plants
- Rare and Sensitive Ecological Communities and Habitats (excluding grasslands)
- Grasslands
- Terrestrial Invertebrates
- Amphibians
- Reptiles
- Migratory Birds (taxa covered under the federal Migratory Birds Convention Act)
- Raptors
- Non-migratory Gamebirds, and
- Mammals.

Indicator taxa were chosen for each VC. A preliminary list of Red- and Blue-listed and SARA-Schedule 1 terrestrial wildlife and plant taxa thought to be present in the Kamloops forest district was generated using Species Explorer (BC Conservation Data Centre 2014a). That list was refined based on the biogeoclimatic subzone variants and habitat types present as identified by the TEM, the known ranges of the taxa, and comments from the public and regulatory agencies to produce a refined list of indicators **(Appendices 4-6)**. Some of the taxa identified from this assessment were targeted during field surveys.

Terrestrial Vegetation

The rare plants VC includes both vascular and non-vascular plants and lichen taxa that are listed as at-risk federally and/or provincially and are potentially present in the LSA (see **Appendix 4**). More common plant species with traditional FN values were also included under this VC. Rare and sensitive ecosystems include non-grassland rare ecological communities Red- or Blue-listed by the BC CDC (**Appendix 5**), as well as wetlands and alkaline ponds, rock outcrops, and old-growth forests. The Grasslands VC is defined as all grasslands, including Red- and Blue-listed ecological communities that are grasslands as well as grassland site series that are not listed as at-risk.

The wildlife VCs and indicators are listed in **Table 3-1** below. A brief description of the Project VCs for terrestrial wildlife and the chosen indicator species is provided below.

Terrestrial Invertebrates

A wide variety of terrestrial invertebrates is present in the LSA, but the biology of many taxa is poorly known. Listed taxa potentially present in the LSA include four Blue-listed butterflies. The monarch (*Danaus plexippus*), Nevada skipper (*Hesperia nevada*), common sooty wing (*Pholisora catullus)* and California hairstreak (*Satyrium californica)* may be present in the LSA (BC Conservation Data Centre 2014a). The olive clubtail (*Stylurus olivaceus*) is a Red-listed dragonfly that has been found along the South Thompson River near Kamloops (COSEWIC 2011a). It is listed as Endangered under *SARA*. The five species listed above will be the indicators for this VC. More details on the biology of terrestrial invertebrate indicators are provided in Section 8.0.

Amphibians

Amphibians present in the LSA include (but are not limited to) the Great Basin spadefoot (*Spea intermontana),* the western toad (*Anaxyrus boreas)*, the Northern Pacific treefrog (*Pseudacris regilla)*, and the Columbia spotted frog (*Rana luteiventris)*. These four species figure in traditional stories of the Secwepemc people (Ignace 2014). All four species will be assessed as indicators for this VC.

Reptiles

Reptiles known or potentially present in the Ajax LSA include the rubber boa (*Charina bottae)*, the Great Basin gophersnake (*Pituophis catenifer deserticola)*, the North American racer (also known as the western yellow-bellied racer; *Coluber constrictor)*, the western rattlesnake (*Crotalus oreganus)*, the common gartersnake (*Thamnophis sirtalis)* and the western terrestrial gartersnake (*Thamnophis elegans)*. The rubber boa, gophersnake, racer, and rattlesnake will be assessed as indicators for this VC.

Table 3-1 Indicator Species for Terrestrial Wildlife VCs

Common Name	Scientific Name	COSEWIC Status*	BC Status**	SARA Schedule	Identified Wildlife?	Conservation Framework			
						Highest Priority	Goal 1	Goal 2	Goal 3
TERRESTRIAL INVERTEBRATE VC									
Monarch	*Danaus plexippus*	SC	B	1 – SC	No	2	6	2	3
Nevada skipper	*Hesperia nevada*	-	B	-	No	2	4	2	3
Common sooty wing	*Pholisora catullus*	-	B	-	No	4	6	4	4
California hairstreak	*Satyrium californica*	-	B	-	No	4	6	4	4
Olive clubtail	*Stylurus olivaceus*	E	R	-	No	1	4	6	1
AMPHIBIAN VC									
Columbia spotted frog	*Rana luteiventris*	NAR	Y	-	No	2	3	2	4
Great Basin spadefoot	*Spea intermontana*	T	B	1-T	Yes	1	6	1	2
Northern Pacific treefrog	*Pseudacris regilla*	-	Y	-	No	6	6	6	6

Common Name	Scientific Name	COSEWIC Status*	BC Status**	SARA Schedule	Identified Wildlife?	Conservation Framework			
						Highest Priority	Goal 1	Goal 2	Goal 3
Western toad	*Anaxyrus boreas*	SC	B	1-SC	No	2	3	2	4
REPTILE VC									
Northern rubber boa	*Charina bottae*	SC	Y	1-SC	No	1	5	1	3
Great Basin gophersnake	*Pituophis catenifer deserticola*	T	B	1-T	Yes	2	6	6	2
Western rattlesnake	*Crotalus oreganus*	T	B	1-T	Yes	2	6	2	3
North American Racer	*Coluber constrictor*	SC	B	1-SC	Yes	2	6	2	3
MIGRATORY BIRD VC									
American Bittern	*Botaurus lentiginosus*	-	B	-	Yes	2	5	2	3
Barn Swallow	*Hirundo rustica*	T	B	-	Yes	2	6	2	3
Long-billed Curlew	*Numenius americanus*	SC	B	1-SC	Yes	2	4	2	3

Common Name	Scientific Name	COSEWIC Status*	BC Status**	SARA Schedule	Identified Wildlife?	Conservation Framework			
						Highest Priority	Goal 1	Goal 2	Goal 3
Common Nighthawk	*Chordeiles minor*	T	Y	1-T	No	2	6	2	4
Great Blue Heron	*Ardea herodias herodias*	-	B	-	Yes	2	6	2	3
Lewis's Woodpecker	*Melanerpes lewis*	T	R	1-T	Yes	2	3	6	2
Williamson's Sapsucker	*Sphyrapicus thyroideus thyroideus*	E	B	1-E	Yes	2	4	6	2
Olive-sided Flycatcher	*Contopus cooperi*	T	B	1-T	No	2	5	2	3
Sandhill Crane	*Grus canadensis*	NAR	Y	-	Yes	5	6	6	5
Waterfowl	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
RAPTOR VC									
Burrowing Owl	*Athene cunicularia*	E	R	1-E	Yes	2	6	6	2
Bald Eagle	*Haliaeetus leucocephalus*	NAR	Y	-	No	6	6	6	6

Common Name	Scientific Name	COSEWIC Status*	BC Status**	SARA Schedule	Identified Wildlife?	Conservation Framework			
						Highest Priority	Goal 1	Goal 2	Goal 3
Flammulated Owl	*Otus flammeolus*	SC	B	1-SC	Yes	2	5	2	3
Great Gray Owl	*Strix nebulosa*	NAR	Y	-	No	4	6	4	5
Prairie Falcon	*Falco mexicanus*	NAR	R	-	Yes	2	6	6	2
Peregrine Falcon	*Falco peregrinus anatum*	SC	R	1-SC	No	2	5	6	2
Rough-legged Hawk	*Buteo lagopus*	NAR	B	-	No	2	6	6	2
Short-eared Owl	*Asio flammeus*	SC	B	1-SC	Yes	2	6	2	3
Swainson's Hawk	*Buteo swainsoni*	-	R	-	No	2	6	6	2
NON-MIGRATORY GAMEBIRD VC									
Columbian Sharp-tailed Grouse	*Tympanuchus phasianellus columbianus*	-	B	-	Yes	2	2	6	2

Common Name	Scientific Name	COSEWIC Status*	BC Status**	SARA Schedule	Identified Wildlife?	Conservation Framework			
						Highest Priority	Goal 1	Goal 2	Goal 3
Ruffed Grouse	*Bonasa umbellus*	-	Y	-	No	2	4	2	4
MAMMAL VC									
Moose	*Alces americanus*	-	Y	-	No	6	6	6	6
Mule deer	*Odocoileus hemionus*	-	Y	-	No	6	6	6	6
Badger	*Taxidea taxus*	E	R	1-E	Yes	1	6	6	1
Great Basin pocket mouse	*Perognathus parvus*	-	R	-	No	2	4	6	2
Little Brown	*Myotis lucufugus*	E	Y	-	No	5	6	6	5
Fringed myotis	*Myotis thysanodes*	DD	B	3	Yes	3	5	6	3
Spotted bat	*Euderma maculatum*	SC	B	1-SC	Yes	2	5	2	3
Western small-footed myotis	*Myotis ciliolabrum*	-	B	-	No	3	6	6	3

Common Name	Scientific Name	COSEWIC Status*	BC Status**	SARA Schedule	Identified Wildlife?	Conservation Framework			
						Highest Priority	Goal 1	Goal 2	Goal 3
Townsend's big-eared bat	*Corynorhinus townsendii*	-	B	-	No	2	5	2	3

*E=Endangered, T=Threatened, SC=Special Concern, NAR = Not At Risk

** R = Red-listed (Extirpated, Endangered or Threatened), B = Blue-listed (Vulnerable), Y= Yellow-listed (Not At Risk)

Migratory Birds

The Ajax LSA is used by a wide variety of migratory birds including songbirds (e.g. woodpeckers, swallows, thrushes, hummingbirds, warblers), waterfowl and other water-associated birds (ducks, geese, swans, coots, loons, grebes, gulls), shorebirds (e.g. sandpipers), pigeons and herons. The LSA lies along the northern edge of the Douglas Plateau Important Bird Area, where Bobolink (*Dolichonyx oryzivorus*), Brewer's Sparrow (*Spizella breweri*), Sandhill Crane (*Grus canadensis*), Common Nighthawk (*Chordeiles minor*), American Avocet (*Recurvirostra americana*), Black Tern (*Chlidonias niger*), and Yellow-headed Blackbird (*Xanthocephalus xanthocephalus*) are migratory species of note (Bird Studies Canada 2012). Indicator species for this VC will include American Bittern (*Botaurus lentiginosus)*, Barn Swallow *Hirundo rustica*, Common Nighthawk, Great Blue Heron (*Ardea herodias herodias*), Lewis's Woodpecker (*Melanerpes lewis)*, Olive-sided Flycatcher, Long-billed Curlew (*Numenius americanus*), Sandhill Crane, and Williamson's Sapsucker (*Sphyrapicus thyroideus thyroideus)*. Waterfowl (a multi-species group which for the purposes of assessment will also include the non-waterfowl species in the shorebird and water-associated bird groups) will also be used as an indicator. Of these indicators the Great Blue Heron and Sandhill Crane also have value to the Secwepmc (Ignace 2014).

Raptors

A variety of raptor species (owls, eagles, Osprey, hawks, falcons, and vultures) is expected to use the Ajax LSA. Indicator species for this VC will include the Burrowing Owl (*Athene cunicularia)*, Bald Eagle (*Haliaeetus leucocephalus)*, Flammulated Owl (*Psiloscops flammeolus)*, Great Gray Owl (*Strix nebulosa*), Short-eared Owl (*Asio flammeus*), Peregrine Falcon (*Falco peregrinus),* Prairie Falcon (*Falco mexicanus),* Rough-legged Hawk *(Buteo lagopus)* and Swainson's Hawk (*Buteo swainsoni)*. The Golden eagle, Long-eared Owl, Great horned Owl and Osprey are other raptor species with traditional uses (Ignace 2014).

Non-migratory Gamebirds

Native gamebirds known or likely present in the Ajax LSA include Ruffed Grouse (*Bonasa umbellus)*, Sharp-tailed Grouse *columbianus* subspecies (*Tympanuchus phasianellus columbianus),* and Dusky Grouse *(Dendragapus obscurus)*. All three grouse species are hunted and have value to First Nations (Ignace 2014). The Columbian Sharp-tailed Grouse and Ruffed Grouse will be assessed as the indicators for this VC.

Mammals

Bats are important predators of night-flying insects. As many as 11 bat species may use the LSA, some of which are of conservation concern. Little brown myotis (*Myotis lucifugus*), Fringed myotis (*Myotis thysanodes*), spotted bat (*Euderma maculatum*), western small-footed myotis (*Myotis ciliolabrum*), and Townsend's big-eared bat (*Corynorhinus townsendii)* will be assessed as indicators for this VC.

Mule deer (*Odocoileus hemionus*), white-tailed deer (*Odocoileus virginianus*) and moose (*Alces americana*) are known to use the LSA. Porcupines (*Erethizon dorsatum*), beaver and a variety of smaller rodents (e.g. yellow-bellied marmots *Marmota flaviventris*), red squirrels (*Tamiasciurus hudsonicus*) are known present. There are historical records of Great Basin pocket mouse

(*Perognathus parvus)* from the Kamloops vicinity. Carnivores that use the LSA include coyotes, cougar (*Puma concolor*), black bear (*Ursus americanus),* American badger, and the long-tailed weasel *Mustela frenata*. Badger, Great Basin pocket mouse, moose and mule deer were chosen as indicators for this VC.

Other mammalian species present on site that have known Secwepmc uses include; coyote, wolf, snowshoe hare, lynx, bobcat, striped skunk, mink, chipmunk, woodrat, muskrat, deer mouse, squirrel, and fox.

4.0 TERRESTRIAL HABITATS

4.1 Biogeoclimatic Variants

Forests are mainly composed of Douglas-fir (*Pseudotsuga menziesii*), trembling aspen (*Populus tremuloides*) and ponderosa pine (*Pinus ponderosa*); although at present much of the pine is standing dead due to pine beetle attack (**Plate 4-1**). The dead pine is expected to fall at the rate of 3-5% per year, although up to 50% of beetle-killed ponderosa pine snags fell in a single severe windstorm reported at one study area (Schmid et al. 1985).

Plate 4-1 Jacko Lake with Dead Pine (C. Bjork photo)

No major rivers are present within the LSA, but small, mostly alkaline lakes and permanent and temporary ponds are relatively common. Jacko Lake, located in the northwestern portion of the LSA, is the largest waterbody in the LSA and is popular for recreational fishing. Peterson Creek crosses through the northeastern portion of the mapped area. A number of historical mining developments are present in the LSA, some of which have been reclaimed.

Four biogeoclimatic subzone variants are present within the LSA (**Figure 4-1**):

- Bunchgrass very dry hot, Thompson variant (BGxh1). A very small portion of this variant is present in the northwestern portion of the LSA on the waterline route south of Kamloops Lake.
- Bunchgrass very dry warm, Nicola variant (BGxw1). This variant is found along Peterson Creek on the eastern edge of the LSA, and along the waterline and powerline routes.
- Ponderosa Pine very dry hot, Thompson variant (PPxh2). This variant was mapped in the northwest edge of the LSA, north of Inks Lake on the lower slopes of Sugarloaf Hill.
- Interior Douglas-fir very dry hot, Thompson variant (IDFxh2). This variant makes up most of the LSA. This variant was formerly made up a forested phase and a grassland phase.

The variants are described in more detail below (information from (Lloyd et al. 2005).

The BGxh2 occupies areas of 250-800 m in elevation. It has hot, dry summers and mild, dry winters, with little snow. Landscapes are generally dominated by grassland and sagebrush ecosystems, and trees (ponderosa pine, Douglas-fir, cottonwood (*Populus balsamifera*), aspen are rare and occur only on moister sites and gullies. Bluebunch wheatgrass (*Pseudoroegneria spicata*) and big sage (*Artemisia tridentata*) are the most common vegetation species

The BGxw1 is found at elevations of 650 m to 1050 m, above the BGxh2, and has more forested area than the BGxh2. Closed stands of ponderosa pine and Douglas-fir occur on steep north aspects and on coarse-textured soils. Trembling aspen and cottonwood are disclimax species. Grasslands are dominant climax communities, with some shrubs (big sage, rabbitbrush (*Ericameria nauseosa*), rose) present in mid-seral communities.

The PPxh2 is found at elevations from 400 m to 1050 m (depending on aspect). The dominant tree species is ponderosa pine, with Douglas-fir present on cool aspect or moist sites. Paper birch (*Betula papyrifera*) and black cottonwood are found on moist riparian areas, and saskatoon (*Amelanchier alnifolia*) and rose (*Rosa* spp.) are common understorey shrubs. Grasslands are common where soil texture is fine and on steep, warm aspects. Rough fescue (*Festuca campestris*) and bluebunch wheatgrass are the most common native grasses, and big sage is common. Wetlands are dominated by saltgrass (*Distichlis spicata*), cattails (*Typha latifolia*), bulrushes (*Schoenoplectus* spp., *Scirpus* spp.) and sedges (*Carex* spp.).

The IDFxh2 is found at 400 m to 1300 m in elevation, and is primarily forested with Douglas-fir, with a component of ponderosa pine. Paper birch, cottonwood and occasionally larch (*Larix laricina*) also occur. Common shrubs include snowberry (*Symphoricarpos alba*), rose, saskatoon and birch-leaved spirea (*Spiraea betulifolia*).

The biogeoclimatic subzones within the LSA are classified as natural disturbance type (NDT) 4. Ecosystems in NDT4 have frequent stand-maintaining fires. "Surface fire return intervals for the PP and IDF biogeoclimatic zones historically ranged from 4 to 50 years; stand-initiating crown fires were rare in the PP and occurred at intervals ranging from at least 150 to 250 years or more in the IDF" (BC Ministry of Forests 1995)

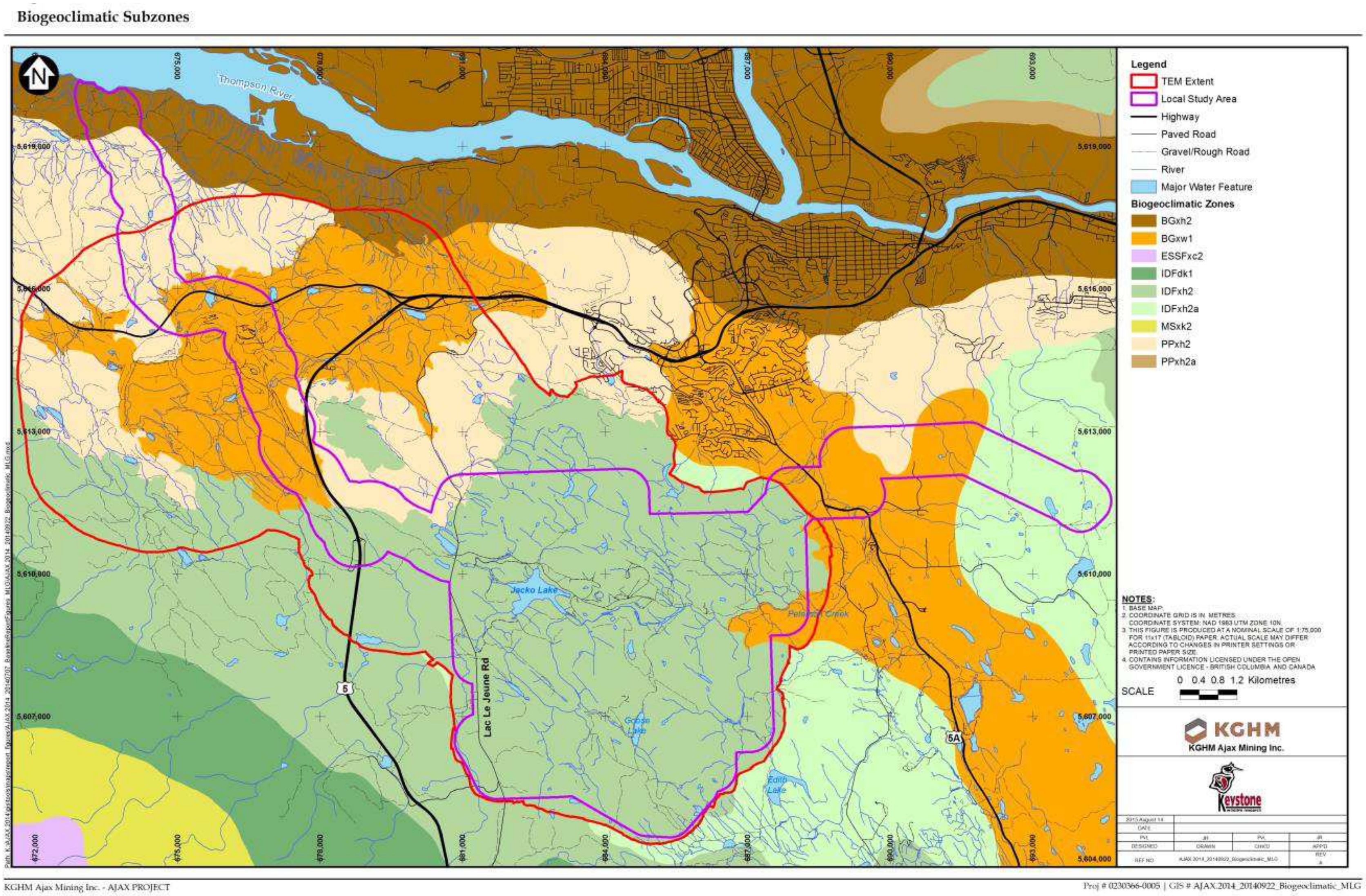


Figure 4-1 Biogeoclimatic Subzones

4.2 Bioterrain

The LSA lies within the Thompson Plateau, a subdivision of the Interior Plateau Physiographic Region (Holland 1976). The Thompson Plateau is characterized by a gentle, undulating upland surface, separated by large valleys.

Bedrock Geology

The LSA is underlain by the Iron Mask Batholith according to Logan and Mihalynuk (2006) In general, the central portion of the LSA is underlain by intrusive bedrock of the Triassic-aged Iron Mask Batholith, including diorite, monzonite and quartz monzonite. The areas bordering the batholith to the northeast and southeast are underlain by volcanic and sedimentary bedrock of the Late Triassic Nicola Group. The volcanic rocks include breccia, tuff, and porphyry and the sedimentary rocks include siltstone, chert, and limestone. Most of the area north of Highway 1 is underlain by volcanic bedrock of the Eocene-aged Kamloops Group.

Characteristics of bedrock, such as mineral composition and structure determine the shape and texture of its weathered material. These characteristics influence the shape and size of clasts and the matrix texture of soils that are created.

Intrusive bedrock, such as, diorite, monzonite and quartz monzonite, tend to break down into sand and coarse silt. Thus, till and colluvium derived from these types of bedrock typically has a silty sand matrix. Well-jointed intrusive bedrock and coarse-grained metamorphic rocks break into large blocks and boulders. These rock types tend to produce low nutrient regimes.

Fine-grained sedimentary rocks, such as siltstone, weather to create a silty soil matrix. This bedrock typically fractures along foliation planes and jointing to create pebble-sized rubble and slabs. Silt that weathers from finer sedimentary and metamorphic rock types create more erodible soil and are more susceptible to cutslope slumping than rock types that weather to sand. These rock types are relatively nutrient-rich.

Non-siliceous volcanic bedrock typically breaks down into rubble and blocks, which weather into silt and clay. Silt and clay that weathers from volcanic bedrock and the finer sedimentary create more erodible soil and are more susceptible to cutslope slumping than rock types that weather to sand. Non-siliceous volcanic rock tends to give rise to moderate nutrient regimes (i.e. basalt). Like intrusive bedrock, rock with higher silica content (i.e. rhyolite) gives rise to low nutrient regimes.

Landscape Evolution

The present physiography dates back two hundred million years (early Jurassic), when plate tectonics welded the former Pacific Ocean to the margin of the North American continent. This created ridges of metamorphic and plutonic bedrock oriented in a north-south direction. About 50 million years ago (early Tertiary), plate tectonics caused uplift of the area accompanied by extensive volcanism. A long period of relative stability followed, during which erosion and deposition formed a low-relief landscape with gentle slopes and low hills. During late Tertiary, the area was subject to uplift again, followed by a renewed period of down cutting, with the stream valleys deeply incising into the old erosion surface.

Both the upland surface and the steep-sided valleys were completely buried by ice during the Pleistocene glaciation; however, glaciers effected only relatively minor modifications to the older topography. Most of the surficial materials that are of significance with regards to land management date from the last glaciation.

At the beginning of the last major glacial episode (Fraser Glaciation), ice accumulated in the high mountains and then gradually spread to valleys and lowlands. About 14,500 years ago, when the Cordilleran Ice Sheet was thickest and most extensive at the climax of Fraser Glaciation (Fulton 1965), ice flowed generally from the northwest to the southwest across the LSA. The rounded ridge tops suggest that the entire area was completely overridden by ice at this time, depositing till at the base of the ice sheet.

Deglaciation occurred between about 14,000 and 11,000 years ago. Deglaciation took place by down-wasting so that the uplands emerged from beneath the ice while tongues of ice remained in the valley bottoms (Fulton 1969). Stagnant ice in the valley bottoms impounded Glacial Lake Thompson, a large but temporary glacial lake along the Thompson, South Thompson and North Thompson River Valleys. Down-wasting ice often forms characteristic sub-glacial and ice-marginal landforms on gentle surfaces, such as eskers, kames, and meltwater channels.

During post-glacial times, processes have re-worked some glacial sediments and weathered bedrock to redistribute them as colluvium and fluvial sediments. Some streams and rivers that have graded to the present day lake level have downcut into glacial deposits creating terraces, benches, and steep-sided scarps. Eolian sediments have been transported and deposited on the gentler slopes, generally along the northern and northeastern edge of the LSA. Fine-grained sediments have accumulated in depressions due to slope wash.

Soils

Since the last glaciation, the surface layers (between 0 cm and 70 cm) of many surficial materials have been slowly altered by soil-forming processes such as weathering and biological activities. These physical and chemical changes to the upper layer of the surficial materials affect the fertility of the soil and the plants that grow on them. Although soils have not been mapped during the current Project, the full plots provide descriptions of the soil at the corresponding site. Soils were mapped by Young et al. (1992), and the Canadian System of Soil Classification (Soil Classification Working Group 1998) provides detailed descriptions of the soil taxonomy. The commonly found soils within the LSA are briefly described below.

Chernozems

Chernozems are soils that form in grassland (Interior Bunchgrass zone) and grassland/open forest (Interior Douglas-fir and Ponderosa Pine zone) communities and are characterized by their dark surface layer called an “Ah” horizon. This rich dark horizon is formed by the accumulation of decayed roots and plant matter of grassland plant species. Within the LSA, chernozems are common below about 1520 m and in general, the soil colour darkens from brown to dark brown to black with increasing precipitation and elevation (Young et al. 1992).

Brunisols

Brunisols form in the lower elevation forested terrain, including the Interior Douglas-fir zone. This soil type is characterized by the "Bm" horizon, which means the soils are poorly developed, though more developed than a regosol. Eutric brunisols tend to occur on the lower and drier elevations in the LSA and dystric brunisols on the higher, moister elevations (Young et al. 1992). The dystric brunisols are more acidic than the eutric brunisols and the eutric brunisols contain more available plant nutrients (Young et al. 1992)

Regosols

Regosols can occur anywhere in the LSA where the soils are young (i.e., floodplains, talus slopes) and/ or have been disturbed by, for example, natural mass movement processes (landslides) or anthropogenic earth-moving (mining activities), so that soil-forming processes have affected little to no visible change to the upper soil layer (i.e. there is no B horizon).

Luvisols

Luvisols develop in fine-grained surficial materials, such as, glaciolacustrine sediments and fine-grained till and are characterized by a clay-rich layer known as the Bt horizon. These soils occur in the LSA on mid-elevation forested areas underlain by fine grained till (Young et al. 1992).

Organic

Organic soils form from the accumulation of plants in wet conditions, generally wetlands, and where decomposition rates are relatively slow. Within the study area, the wetlands are marshes, which are wetlands characterized by mineral soils covered by a thin layer of organic (this layer must be thicker than 60 cm to classified as an organic soil). They occur in poorly drained depressions throughout the mapped area.

Gleysols

Gleysols develop in poorly drained depressions and are defined by the soil colour and mottling caused by the periodic or sustained reducing conditions that occur when the soil is saturated. Within the mapped area, these soils may be found in poorly drained depressions, and where the organic layer is less than about 60 cm thick.

Mining and Reclamation History

Copper mining and milling took place from 1977 to 1997, and included open pit mining operations at the Afton, Crescent-Afton, Pothook and Ajax (East and West) pits as well as ore smelting (Golder Associates 2003). Hughes Lake was dammed and used as a tailings storage facility. Revegetation programs began at a large scale in 1987. Reclamation programs focused primarily on developing suitable forage for wildlife (ungulates and bears) and cattle, and on stabilization of disturbed areas. Reclamation activities have included distribution of topsoil and contouring, fertilization, and seeding of rock piles, marsh vegetation development in Hughes Lake, and wetland development in Ajax retention ponds. Vegetation species planted as part of wetland development included cattails, rushes and sedges (Golder Associates 2003).

4.3 Terrestrial Ecosystem Mapping

Ecosystem mapping at a scale of 1:20,000 was completed for an area extending from Highway 1 south and west to Edith Hill (**Figure 4-1**), and was used to assess wildlife habitat and ecosystem diversity.

TEM mapping was prepared for most of the LSA and field-truthing of the habitat mapping and species-specific surveys were focused within that area. The powerline to the northeast and waterline to the northwest were not mapped as the water line follows existing infrastructure and pole-placement for the powerline will minimize disturbance. The LSA includes portions of 1:20,000 mapsheets 092I.068-69 and 092I.058-59. One ecosection is present, the Thompson Basin (THB). The THB ecosection is a warm and very dry, low-elevation area of predominantly gentle slopes (Demarchi 2011).

Methods

<u>Data Sources</u>

The terrestrial ecosystem mapping (TEM) methodology was consistent with that described in RISC Standards for Terrestrial Ecosystem Mapping (Resources Inventory Committee (RIC) 1998a). Data sources used in the ecosystem mapping included:

- Aerial Photographs (colour, 2000) at 1:15,000: 30BCC00009 #35-41, 70-77, 135-139; 30BCC00052 #87-91, 93-97; 30BCC00051 #68-70, 194-199; 30BCC00010 #5-8, 69-72, 75-76; 30BCC00022#28-33, 100-103.
- Digital TRIM base mapping
- Regional soils mapping (Young et al. 1992)
- 1:20,000 Vegetation Resources Inventory (VRI) mapping
- 1:250,000 biogeoclimatic zone mapping.

<u>Bioterrain Mapping</u>

Bioterrain mapping is a method to categorize, describe and delineate characteristics of surficial materials (the loose materials on top of bedrock), terrain texture, landforms, geomorphological processes (the active mechanism that continue to shape the landscape) and soil drainage within the natural landscape (BC Ministry of Forests 1999). Bioterrain mapping is a primary building block for TEM.

A bioterrain map is a map of surficial materials; it shows the surficial material type and thickness combined with surface expression or landform type (and geomorphological processes if applicable). Each surficial material type is classified based on its method of deposition. For example, materials deposited in a river environment (fluvial and glaciofluvial sediments) have characteristic physical properties such as texture, bedding and consolidation that differ from material deposited at the base of a glacier (till).

Terrain maps are the basis for many kinds of land use planning, including terrain stability, ecosystem mapping, planning of urban roads and development, assessment of geological hazards, and aggregate mining. Terrain mapping with an ecological emphasis is called bioterrain mapping. Bioterrain mapping forms the basis of terrestrial ecosystem mapping (TEM) by delineating polygons with similar ecological conditions such as soil moisture, aspect, and vegetation characteristics.

Bioterrain mapping is based on air photo interpretation, which is then ground-truthed in the field. For this Project, terrain mapping followed the standard British Columbia procedures for terrain classification (Howes & Kenk 1997), mapping methods (Resources Inventory Committee (RIC) 1996), and bioterrain mapping methodology (Resources Inventory Committee (RIC) 1996, 1998a). Delineation was based on the following:

- terrain type;
- material depths;
- drainage;
- slope breaks;
- slope position;
- aspect: cool (285 to 135°) and warm (135 to 285°);
- geomorphological processes;
- surface expression and slope morphology (e.g., concave or convex);
- vegetation changes;
- riparian zones and corridors;
- any other ecologically significant areas such as cliffs, talus slopes, and ponds.

Preliminary bioterrain mapping was completed on colour aerial photographs at a scale of approximately 1: 15 000. A bioterrain legend is presented as **Appendix 1**.

<u>Pre-Typing and Preparation of Draft Map</u>

Ecosystem mapping was completed by a certified TEM mapper, using methods described in RIC (1998a). The air photos were viewed stereoscopically and the bioterrain polygons subdivided into ecosystem polygons based on the latest version of regional ecosystem descriptions in Lloyd et al. (2005) (**Appendix 2**). Although those descriptions are still draft, the Regional Ecologist recommended they be used rather than the older versions of the regional map units (D. Lloyd, BC MoF, pers. comm.). As two-letter ecosystem codes and assumed modifiers were not defined for the new unit descriptions at the time of mapping, the mapping did not incorporate any assumed modifiers, and the numbered site series codes were used in the map labels. Non-vegetated and anthropogenic ecosystems were mapped using the ‘00’ site series and the standard two-letter code for the ecosystem (Resources Inventory Committee (RIC) 1998a).

The ecosystems described in Lloyd et al. (2005) also included a number of seral grassland units. Those seral units differ from one another in the composition of grasses. As it is not possible to detect differences in grass species from the airphotos, the seral units were not mapped, although field plots identified ecosystems to seral unit wherever possible.

The ecosystems and structural stages were interpreted from the air photos and from the VRI mapping. The photos were typed into numbered polygons. Each terrestrial polygon was assigned a structural stage, which represents the seral development stage of the vegetation (see **Appendix 2** for structural stage definitions). Bioterrain and ecosystem information for each polygon was entered into a database.

Polygon linework on hardcopy photos was digitized onto the map base (1:20,000 TRIM) using monorestitution. Additions to the TEM that were completed in 2013 and 2014 used digital photos and linework was applied digitally using PurView software and a computer adapted for viewing the digital photos in stereo.

The polygon lines of permanent features (roads, watercourses) were adjusted to fit the TRIM base. The latest version of the regional 1:250,000 biogeoclimatic subzone coverage was obtained from the Regional Ecologist and overlain onto the polygon coverage, and BEC subzone boundaries were adjusted to match the scale of the ecosystem mapping. A draft labelled map was prepared at 1:20,000-scale in preparation for field-truthing. A draft map legend was also prepared that listed and defined all of the mapped ecosystems.

Field-Truthing

Field sampling followed protocols described in BC Ministry of Environment, Lands and Parks and BC Ministry of Forests (1998). Two or three-person crews completed full plots, Ground Inspection Forms (GIFs) and visual inspections to truth the draft mapping. Efforts were made to sample within all BEC zones and major habitat types, however, availability of access and private land restrictions constrained sampling distribution. All field data were entered into the provincial standard VENUS software. Additional data were also obtained from soil and vegetation surveys completed by other disciplines working on the Project.

Preparation of Final Mapping

The field-truthing data was used to adjust the mapping and create a final map. A Digital Elevation Model (DEM) was used to generate slope/aspect modifier classes for each map polygon, and those modifiers were included in the polygon labels. The provincial 1:250,000 subzone lines were refined based upon elevation and field plot data and fitted around the map polygons. Quality assurance protocols were run on the spatial map data as well as the map database, and any errors identified were addressed.

The map legend was finalized, and an expanded legend was prepared. Additional field plots were completed during the 2008 wildlife surveys and in 2014, and the map has been edited where required.

Areas of recent disturbance may not be accurately mapped within the TEM. Ecosystem mapping is based on the most current aerial photos and digitized vegetation information available at the time of mapping. Natural or manmade disturbances or forest harvesting that has occurred in the mapped area after the aerial photos were taken may not be reflected in the ecosystem mapping.

Results

The total area of the LSA (7,167 ha) covered by the TEM is 5,943 ha (83% of the LSA). The portions of the LSA not included in the TEM are the water supply route to the northwest, where the Project will almost entirely make use of existing infrastructure, and the powerline route to the northeast where disturbance will be minimal.

Field-Truthing

Field-truthing took place from August 16 to 21, 2007, June 23 to 26, 2010, and August 12 to 15, 2014. In total, 15 full plots, 159 Ground Inspection Forms (GIFs) and 319 visual checks were completed **(Figure 4-2)**. These include GIF and visual plots that were done during wildlife surveys. Additional soils and surficial geology data that were collected for geotechnical purposes were also used to truth the bioterrain mapping. The distributions of TEM field plots by site series and structural stage are listed in **Table 4-1** (see **Appendix 2** for site series and structural stage definitions).

Table 4-1 Summary of TEM Field-truthing Plot Types

SubzoneVariant	Full Plot	Ground Inspection	Visual Inspection	Grand Total
BGxw1	3	10	53	66
IDFxh2	9	137	221	367
PPxh2	3	12	45	60
Grand Total	15	159	319	493

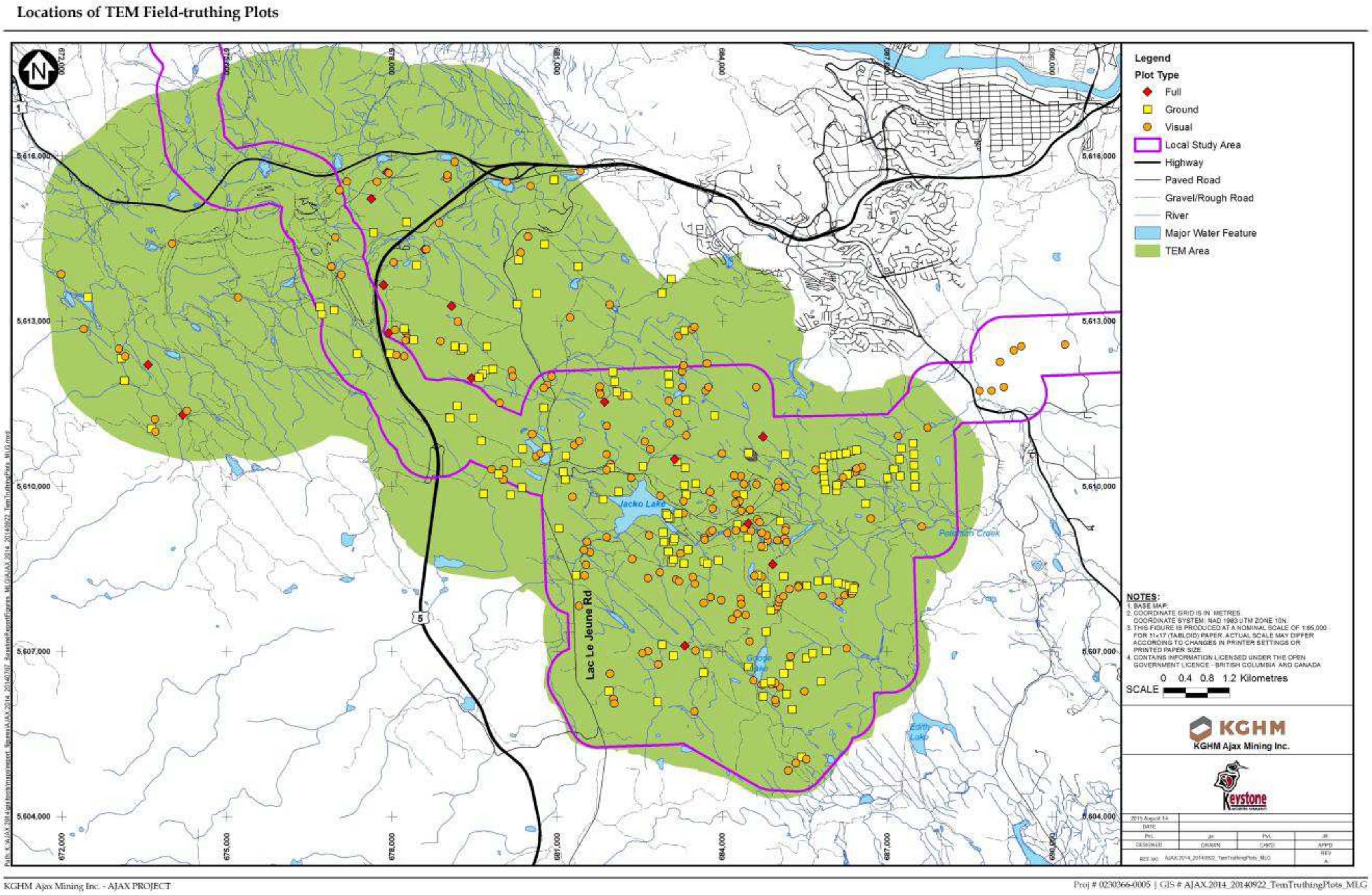


Figure 4-2 Locations of TEM Field-truthing Plots

Surficial Materials

A description of the surficial materials mapped is presented below.

Anthropogenic Material (A)

Anthropogenic materials are deposits that are sufficiently reworked or redistributed by human activities that their original character is lost. Examples include gravel pits and fill used for roads and other construction. Anthropogenic soils were mapped where waste rock and tailings have been placed as a result of mining activities. Anthropogenic is also mapped on the existing haul road.

Colluvium (C)

Colluvium has accumulated during post-glacial times because of gravity-induced slope movement, for example, rock fall and soil creep. The physical characteristics of colluvium are closely related to its source and mode of accumulation. Four processes generally create colluvial deposits; (1) rockfall from bedrock bluffs, (2) soil creep in weathered bedrock, (3) mass movement processes in surficial materials (debris flows and debris slides), and (4) rockslides and rock slumps.

Rockfall from bedrock bluffs typically forms talus slopes (Ck). Talus is loosely packed rubble or blocks with little interstitial silt and sand near the surface, and is rapidly drained. Talus is scattered throughout the mapped area flanking bedrock cliffs. Polygons with rockfall are uncommon. Talus slopes are mapped on Sugarloaf Hill and rockfall could occur from steep rocky slopes scattered throughout the area. Rockfall may also occur on steep slopes in the mined open pits.

Colluvial veneers (Cv) and blankets (Cb) develop where weathered bedrock or surficial materials have been loosened and moved downslope by gravitational processes such as soil creep. It is loosely packed and usually rapidly drained. Colluvial veneers and very thin veneers are most common on upper, moderately steep and steep gradient slopes and as discontinuous, very thin veneers on bedrock-controlled terrain in the watershed. The matrix texture of the colluvium reflects the bedrock or surficial materials from which it is derived. Thin patchy areas of colluvium were mapped on the steep slopes of scattered bedrock hummocks. The material typically has a silty sand texture and is rapidly drained.

Colluvial fans (Cf) and cones (Cc) form at the base of steep gullies due to deposition by debris flows (-Rd). These deposits are generally compact, and sorting may range from poorly sorted to well sorted. The deposit may or may not be matrix supported, and the matrix is usually sand. Colluvial cones and fans are common at the mouths of the large single gullies. No colluvial fans were mapped.

Deep-seated slumps in bedrock and surficial materials result in hummocky, irregular colluvial deposits (Chu). Rock slumps contain blocks and rubble with little or no interstitial silt and sand. Slump/earthflows are mapped north of Highway 1 at the north edge of the mapped area.

Slope Wash (C1)

Slope wash is a result of rainfall events in which non-channellized overland flow carries surface material from a steeper area to a gentler area down slope. The material is generally derived from eolian sediments. Slope wash generally does not travel far and comes to rest on gentler slopes of 0 to 15 %. In the mapped area, it is commonly found as a partial veneer overlying till, fluvial or lacustrine deposits. The typical texture is silty sand or sandy silt with generally less than 5 % coarse fragments. It commonly includes some imperfect drainage as it accumulates in receiving sites. Slope wash has been mapped in scattered linear depressions.

Weathered Bedrock (D)

Weathered bedrock has been modified in situ by mechanical and chemical weathering. Weathered bedrock has been mapped as discontinuous very thin veneer (Dx) overlying gently sloping or undulating bedrock outcrops. It typically contains a high proportion of angular coarse fragments with varying amounts of interstitial silty sand. It is non-cohesive and rapidly to very rapidly drained.

Eolian Sediments (E)

Eolian sediments are transported and deposited by wind are likely to be found downwind from a large source of fine-grained soils, such as glaciolacustrine sediments. They typically occur as a thin cap (Ev) over other materials, but may locally thicken into a blanket or dunes typically consisting of silt and fine sand. In the mapped area, the source of the eolian sediments is the large glaciolacustrine sediment benches found adjacent to the South Thompson, Thompson and Kamloops Lake located to the north. Eolian sediments were not widespread, but were most likely to be mapped along the northern and north eastern edge of the mapped area.

Fluvial Materials (F, FA)

Fluvial materials have been deposited in post-glacial time by streams. Fluvial materials consist of loosely packed, non-cohesive sands and silt with some gravel. Fluvial materials were mapped mainly as small portions of a polygon that include a stream. Fluvial materials are generally mapped as floodplains (Fp, FAp) or gentle fluvial areas (Fj) with imperfect to poor drainage. Floodplains were mapped along Humphrey Creek, Peterson Creek and Alkali Creek. Veneers of fluvial sediments were mapped along many of the small draws.

Glaciofluvial Materials (FG)

Glaciofluvial materials were deposited by glacial meltwater streams at the end of the Fraser Glaciation. Sands and gravels accumulated along ice margins and on top of melting ice (FGu) and downstream of melting ice (FGf and FGp). In some areas, rivers were made and quickly abandoned, depositing blankets of sands and gravels over top of till (FGb). In a few areas, postglacial streams have incised into outwash plains and fans, transforming them into terraces (FGt) and creating erosional slopes (FGk). In general, glaciofluvial materials create well-drained and relatively dry sites due to the highly porous and permeable sands and gravels. The material is non-cohesive and therefore erodible, and will tend to ravel when exposed on steep slopes and road cuts. Glaciofluvial sands and gravels are potential sources of aggregate.

Glaciofluvial sediments were mapped on either side of Humphrey Creek where the creek flows in a west to east direction at the eastern edge of the LSA.

Lacustrine (L)

Lacustrine materials have been deposited from standing bodies of water. Fine sand, silt or clay that has been suspended in the water settles to the lake bed, creating sediments that are commonly stratified and fine textured. These sediments may be exposed when the lake is drained. Lacustrine materials were mapped in shallow ponds that are periodically inundated (szLp and szLv).

Glaciolacustrine (LG)

Glaciolacustrine materials have been deposited from glacial or ice-dammed lakes that were present during and shortly after glaciation. Glaciolacustrine materials generally consist of well to moderately well stratified fine sand, silt and/or clay with occasional lenses of till or glaciofluvial material.

Glaciolacustrine materials are generally only slowly permeable, and so the presence of even a thin layer of this material is sufficient to cause impeded drainage, perched water tables, and surface seepage. These conditions may promote instability in some situations. These fine-textured materials are also susceptible to surface erosion by running water.

Till (M)

Till is deposited directly by glacier ice and is the most common surficial material mapped for the Project. The deposits typically consist of poorly sorted silt, sand and gravels. In general, till on slopes is well drained and moderately-well drained, and in some cases imperfectly drained, in depressions.

Thick till deposits are found throughout the area, especially in grasslands in the northern and eastern side of the LSA. The mid to upper slopes of scattered hills, for example, Sugarloaf Hill, are covered with discontinuous veneers of till. Patches of very thin veneers of till cover areas of undulating bedrock. The typical till is a moderately consolidated, slightly cohesive basal till (terrain texture label "dsz" or "dzs"). A finer-textured basal till (terrain texture label "dsm") was observed in some soil pits and road cuts.

Organics (O)

Organic materials form where decaying plant material accumulates in poorly or very poorly drained areas. Organic materials were uncommon, but were mapped as veneers (Ov) or very thin veneers (Ox) in some of the wetlands.

Bedrock (R)

Bedrock is mapped where it outcrops at the surface. Polygons mapped with thin or very thin material (Cv, Dx, Mv, Mx), may also have a small proportion of bedrock outcrops. Bedrock outcrops are scattered throughout the mapped area.

Geologic Processes

Channelled by Meltwater (-E, -EV)

Meltwater channels form alongside, beneath, or in front of a glacier or ice sheet. Glacial meltwater channels are typically sinuous in plan, flat-floored, and steep-sided in cross-section. The floors of the meltwater channel may contain glaciofluvial sediments, indicative of the water flow that once took place here.

Slow Mass Movement (-F, -F"k, -F"x)

Slow mass movement refers to slope failures where movement occurs slowly and/or where the displaced material moves only a short distance downslope. The double prime symbol (") indicates the initiation zone of slow mass movement. Tension cracks are indicated by the subclass "k" (-Fk). Slump-earthflows are indicated by the subclass "x" (e.g. –Fx).

Tension cracks (-Fk) are open fissures commonly located near ridge tops. They indicate slow slope spreading, and may be the precursor to catastrophic slope failure. A slump-earthflow (-Fx) is a combined slump (upper part) and earthflow (lower part).

Ground Disturbance (-G)

Ground disturbance refers to anthropogenic excavations where the remaining exposed surface has remained undisturbed and is in situ; for example, the cutslopes in gravel pits, mining pits, road cuts.

Surface Seepage (-L)

Seepage is mapped where relatively wet soils are widespread in a polygon. This commonly occurs where soils are on slowly permeable materials such as till, where thin surficial materials overlie bedrock, and on lower slopes where shallow subsurface water is received from a relatively large catchment area further upslope. They may also occur where groundwater is concentrated at the surface by a physical conduit such as a geological fault. In the mapped area, areas of abundant surface seepage are uncommon

Rapid Mass Movement (-R, -R"b, -R"x, -R"r)

Rapid mass movement refers to downslope movement by falling, rolling or sliding of debris derived from surficial material and/or bedrock. Where a double prime symbol (") is used with a mass movement process (e.g., -R"b), slope failure has initiated within the polygon. Mass movement symbols without the double prime symbol (e.g., -Rb) indicate a polygon that contains the transport or deposition zone of rapid mass movement. Transportation zones are generally not recognized as areas where landslides initiate; they may contribute additional volume of transported material to a failure. Transport and deposition zones represent hazardous areas downslope of slides or rockfall.

Rockfall (-Rb, -R"b) occurs when either a single block or a mass of bedrock falls, bounces and rolls downslope. In the mapped area, rockfall from local outcrops creates talus slopes, colluvial veneers and blankets. Polygons with rockfall were mapped in association with local bedrock outcrops or cliffs. For slump-earthflow description (-Rx), see the slow mass movement section above.

Rockslides (-Rr) consist of large masses of disintegrated bedrock that have rapidly slid downslope. Usually initiate from steep bedrock slopes with deep-seated structural weaknesses. The deposits may travel great distances if unobstructed (i.e. wide valley bottom).

Gully Erosion (-V)

Gullies are small ravines with V-shaped cross sections that can form in either glacial drift or bedrock. Gully erosion has been mapped in two kinds of terrain: (i) slopes with several parallel shallow gullies in drift materials (dissected slope) and (ii) single gullies where streams have exploited joints in bedrock or have cut down into thick drift. Gullied terrain is an indicator of either former or active erosion, and the symbol serves to identify material that is potentially subject to erosion or mass movement (e.g., Uk-V). Gully sideslopes and steep headwalls are common sites of slope failures and are classed as potential unstable (Class IV) where there is no evidence of instability and unstable (Class V) where there is evidence of instability. Gully erosion was mapped in polygons scattered throughout the mapped area.

Inundation (-U)

Inundation refers to areas that are seasonally flooded, for example, marshlands.

<u>Ecosystem Units</u>

A breakdown of the LSA by BEC subzone and ecosystem unit and a structural stage breakdown by subzone are presented in **Table 4-2** and **Appendix 3**, (see **Appendix 2** for structural stage definitions). Table 3 in **Appendix 3** also includes a summary of the subzone variants within the portions of the LSA that are not covered by the TEM.

Table 4-2 Biogeoclimatic Variants in the LSA.

BGC Variant	LSA TEM ha	Ha in LSA Outside of TEM	Ha in LSA
BGxh2	0	117.9	117.9
BGxw1	734.0	437.9	1171.9
IDFxh2	4802.1	332.0	5134.1
PPxh2	407.4	336.1	743.5
TOTAL	5943.5	1223.8	7167.3

The majority of the LSA (70%) was mapped as interior Douglas-fir very dry hot, Thompson variant (IDFxh2). Most of this biogeoclimatic variant was mapped as grassland (structural stage 2), and the forested protions were mostly young (structural stages 4 and 5), which is to be expected based upon the area's history of frequent fires. The dominant mapped grassland units were (83) Rough fescue – Bluebunch wheatgrass, followed by (82) Bluebunch wheatgrass – Sandberg's bluegrass. The (01) Fd – Pinegrass – Feathermoss was the dominant mapped forested unit. 407 ha of Poderosa pine, very dry hot, Thompson variant (PPxh2) was mapped in the LSA. The dominant mapped unit was the common forested (01) Py – Bluebunch wheatgrass – Rough Fescue unit. The majority of this zone was mapped as structural stage 2 to 4. The Bunchgrass very dry warm subzone (BGxw1) was mainly mapped as structural stage 2 (grassland/herb), as well as 3 (shrub) for polygons where a cover of sagebrush >15% was present. The dominant unit was the (81) Bluebunch wheatgrass – Sandberg's bluegrass grassland. Very little old forest (structural stage 7) is currently present in the LSA. An expanded legend (Keystone Wildlife Research Ltd. 2007) has been prepared that describes the ecosystems mapped. See **Appendix 3** for more detailed breakdown of TEM results.

Sagebrush Steppe

Though this habitat is often termed grassland in British Columbia, it bears many significant distinctions from true grassland. Not only are grasslands dominated by graminoids and forbs in the near absence of shrubs, but in climates like those of the Kamloops region, they also generally occur on deeper, loamy, low-salinity soils and are often at higher elevations, while sagebrush steppe tends to occupy coarser or more saline soils, usually at lower elevations. Additionally, sagebrush steppe tends to have high cover of acrocarpous mosses and lichens in robust soil-crust communities, while grasslands tend to have more pleurocarpous mosses and fewer lichens in poorly developed soil crusts. The sagebrush steppes in British Columbia are habitat for a very large number of native plant taxa, including some of the rarest in the province. Sagebrush steppe ecosystems (**Plate 4-2**Error! Reference source not found.) have been included in the 'grasslands' VC (see Section 7.0**Error! Reference source not found.**) for the purposes of the assessment.

Plate 4-2 Shrub-steppe Habitat (C. Bjork photo)

Characteristic abundant species in the sagebrush steppe habitats in the Project area include *Antennaria dimorpha, Artemisia frigida, A. tridentata* ssp. *tridentata, Bromus mollis sensu lato, Bromus tectorum, Ericameria nauseosa, Poa sandbergii, Pseudoroegneria spicata, Ranunculus glaberrimus, Selaginella wallacei, Syntrichia ruralis* and *Tortula brevipes*. Species that were found only in sagebrush steppe in the rare plant surveys included *Astragalus collinus, Buellia elegans, Castilleja thompsonii, Erigeron filifolius, Fulgensia bracteata, Galium verum, Ranunculus testiculatus,* and *Sprobolus cryptandrus*. The Common Nighthawk is associated with this habitat. Sagebrush steppe was mapped as structural stage 3 grassland units in the IDFxh2, PPxh2 and BGxw1, and as the 81, 83 and 85 units in the BGxh2.

Grasslands

Distinct from sagebrush steppe not only in the lack or near lack of shrub cover, grasslands also, in the subarid climates of the Thompson Plateau, occur mostly on deeper, richer soils with lower salinity, and have less cover of lichens and acrocarpous mosses (**Plate 4-3**). Grasslands, when treated as a different habitat from shrub steppe, are one of the rarest habitat classes in British Columbia. Characteristic abundant species in grasslands in the Project area include: *Achnatherum nelsonii* ssp. *dorei, Balsamorhiza sagittata, Bromus pumpellianus, Festuca campestris, Helianthella uniflora,* and *Linum lewisii*. Species found during the rare plant surveys only within grassland habitats include *Arnica sororia, Astragalus laxmannii, Bouteloua gracilis, Bromus pumpellianus, Castilleja lutescens, Elymus lanceolatus, Erysimum cheiranthoides, Festuca idahoensis, Festuca rubra* (native form), *Helianthella uniflora, Linum lewisii, Lithospermum incisum, Orobanche ludoviciana, Orthocarpus luteus, Poa cusickii*, and *Rhinanthus minor*. Pine beetle infestation has killed most of the ponderosa pines in what used to be open ponderosa forest. This has left instead open grassland with dead standing trees or recent tree fall, with little or no significant cover of ponderosa saplings. Grassland associated indicator species include butterflies, racer, Long-billed Curlew, Sharp-tailed Grouse, and badger, while raptors frequently use grasslands for hunting prey. Grasslands were mapped as structural stage 2b in the 81, 83, 84 and 85 TEM units in the BGxh2, the 81, 83 and 84 units in the BGxw1, the 81, 82 and 83 units in the IDFxh2, and the 82, 83 and 84 units in the PPxh2.

Plate 4-3 Grassland Habitat (C. Bjork photo)

Wetlands

Wetlands can be divided into two categories based on salt ion concentrations. Saline wetlands were mapped as the Gs01 and Gs02 ecosystems in the TEM. Saline flats (**Plate 4-4**), which generally occur in closed basins and have abundant salt crystals at the soil surface, mostly have the characteristic species: *Atriplex* spp., *Bolboschoenus maritimus, Distichlis spicata, Hordeum jubatum* (both subspecies), *Puccinellia distans, Puccinellia nuttalliana, Salicornia rubra, Suaeda calceoliformis,* and *Symphyotrichum ciliatum.* Moderately saline wetlands (usually with surface drainage or porous soils and minimal salt crystals at the surface upon desiccation) are characterized by *Argentina anserina, Chenopodium glaucum, Chenopodium rubrum, Juncus balticus, Leymus cinereus, Ranunculus cymbalaria, Rumex fueginus,* and *Ruppia cirrhosa*.

Plate 4-4 Saline Wetland (C. Bjork photo)

Non-saline wetlands were also surveyed, and these fall into two basic categories: creek shores, and marshes in depressions and along pond and lake shores. Creek shore habitats differ from basin-wetland habitats in their soil chemistry, since minerals do not as readily accumulate along creeks as they do in still-water basins, and in the soil texture, which tends to be more aerated due to larger particle size and more abundant organic matter. Creek shores were the sole habitat for the species *Agrostis exarata, Barbarea orthoceras, Carex pellita, Heracleum lanatum, Torreychloa pauciflora,* and *Viola palustris*.

The marsh habitats found on margins of lakes and ponds and in shallow depressions have a wide variety of vegetation. Many of them are heavily dominated by *Carex atherodes* or *Carex utriculata*, while others have numerous codominant species that do not produce much cover individually. Species that were found exclusively in marsh habitats include *Cratoneuron filicinum, Glyceria elata, Lycopus uniflorus, Polypogon interruptus, Schoenoplectus acutus, Scirpus microcarpus, Sium suave,* and *Typha latifolia*. Marsh wetlands were mapped as the TEM units Wm01, Wm05, Wm06 and Wm07.

Submerged or floating aquatic vegetation is associated with marsh habitats, but out in standing open water (mapped as shallow open water). The plants of this habitat are highly adapted to their aquatic life, in some cases having alternate forms of photosynthesis or internal gas storage that allows them to compete with algae for dissolved carbon dioxide. Species that were found only in this aquatic habitat were *Ceratophyllum demersum, Lemna minor, Lemna trisulca, Potamogeton pusillus, Potamogeton richardsonii, Stuckenia pectinata,* and the Blue-listed *Stuckenia vaginata*.

Species associated with wetland habitats include dragonflies, amphibians, American Bittern, Great Blue Heron, Sandhill Crane, and waterfowl such as ducks and geese.

Aspen Groves

Small basins and widenings in small drainages in the LSA (**Plate 4-5**) are often occupied by stands of trembling aspen, which spreads by its roots to form a multi-trunk colonial growth. Aspen is a nutrient-pump tree, that is, with the help of symbiotic fungi, it is highly efficient at pulling up nutrients and water from the soil. Some of these nutrients are exuded from the leaves and drip to the ground surface, thereby concentrating macronutrients in uppermost soil layers where they are available for other plant species. This nutrient-pump effect allows a large number of herbaceous plants to thrive under aspen stands whereas they would be excluded from the less nutrient-rich surrounding terrain. Though no plant species were found exclusively in aspen groves, and no rare plants were found in this habitat, it is a plant community worth noting for its high species richness and its loose symbiosis centering on nutrient cycling. The ruffed grouse prefer aspen grove habitats. This plant habitat roughly corresponds to the BGxw1 05/06 and IDFxh2 10-YS variants.

Plate 4-5 Aspen Grove (L. Andrusiak photo)

Shrub Copses

Moist soils in flat or broad microterrain along creeks and in moist hollows in the LSA are often vegetated in sparse to dense stands of shrubs (**Plate 4-6**), foremost among them being species of *Salix, Alnus incana, Betula occidentalis*, and *Cornus stolonifera*. Unlike aspen, these shrubs are poor nutrient-pumps, and so the vegetation below them is not particularly species-rich, and lacks species that require high concentrations of macronutrients. The understory in the shrub copses is often converted to *Phalaris arundinacea*, which is highly invasive in habitats with moist soil. No unique species were found in shrub copses except *Salix bebbiana*. This habitat provides cover for the Sharp-tailed Grouse when in proximity to grasslands. Shrub copses were mapped as the TEM units Fl30 in the PPxh2, and 52 in the IDFxh2, and the wetland units Ws03 and Ws04.

Plate 4-6 Shrub Copse (L. Andrusiak photo)

Sparsely Vegetated Outcrops and Cliffs

Rock outcrops and cliffs are exposures of bedrock that have a soil veneer that is too thin to support the tree growth that would shade out sun-loving plant species. Sparsely vegetated outcrops are those that have no significant overarching tree canopy, and for similar reasons to tree-growth inhibition, shrub cover is also minimal. Exposures of bedrock may also provide unique chemistry to the roots of plants that are dependent on high calcium, magnesium or heavy-metal concentrations. Additionally, sparsely vegetated outcrops can provide a shelter during wildfire, since the vegetation on outcrops may be too sparse to burn. Lichens and plants found in the Project area only on sparsely vegetated outcrops include: *Artemisia michauxiana, Boechera pendulocarpa, Campanula rotundifolia Candelariella rosulans, Cetraria ericetorum, Cladina rangiferina, Cladonia uncialis, Coelocaulon aculeatum, Dermatocarpon miniatum, Drymocallis glandulosa, Eremogone capillaris, Peltula euploca, Sedum lanceolatum, Stephanomeria tenuifolia, Xanthoparmelia wyomingica, Xanthoria elegans*, and *Xanthoria mendozae.* Bat species and the Peregrine Falcon may use cliff habitats. Rock outcrops correspond to the 73, Ro01 and Ro02 ecosystems mapped in the TEM.

Forested Outcrops

Outcrops may be so fractured as to allow establishment of trees along cracks in the bedrock (**Plate 4-7**), or may be so small that they fit under the canopy of trees growing in surrounding deep soils. Forested outcrops generally have far fewer vascular plant and lichen species than sparsely vegetated outcrops, since most plants and lichens are not shade-adapted. Moss diversity may be high on forested outcrops, but in the Project area, this habitat was occupied mostly by a few, hyperdominant moss species. *Cerastium arvense, Homalothecium nevadense, Lomatium triternatum, Ribes oxyacanthoides* and *Phaeophyscia decolor*, were found in the Project area exclusively in this habitat. Forested outcrops correspond to the 02 map unit in the IDFxh2 and PPxh2.

Plate 4-7 Forested Rock Outcrop (L. Andrusiak photo)

Talus

Bases of cliffs and rock outcrops are often characterized by accumulations of cobble-sized or larger rock material fractured and fallen from the bedrock exposures (**Plate 4-8**). These loose rocks form slopes, and soil accumulation is slow. This makes this habitat inhospitable for most plants, though some are specialists in the challenge of germinating on small soil pockets and growing their roots deep down into the talus, where deeper soils and water are available. *Amelanchier alnifolia, Rubus idaeus,* and *Woodsia scopulina* are particularly adept at growing on talus. No species in the Project area were found uniquely in the talus habitat. Snakes may use talus sites as dens. Talus was mapped as Rt01 in the PPxh2, and 72 in the IDFxh2.

Plate 4-8 Talus (L. Andrusiak photo)

Fine Scree

This habitat is formed of sand to gravel-sized rock particles on slopes. It differs from talus in having greater nutrient and water potential close to the surface, whereas plants on talus must be deep rooted to reach soil and water deep below the surface. A large number of plants native to British Columbia grow only on fine scree, particularly in alpine elevations, but also at lower elevations. In the Project area, *Achnatherum hymenoides, Chaenactis douglasii*, and *Phacelia hastata* were found only on fine scree. Fine scree was not distinguished from talus in the TEM, and was mapped as Rt01 in the PPxh2, and 72 in the IDFxh2.

Dry Gullies

Steep-sided drainages with no or only intermittent stream flow occur in various parts of the Project area. These gullies sometimes function as cool-air drainages, channelling and holding cooler air than the surrounding terrain, thereby providing habitat for higher elevation species that require cooler temperatures. Only *Acer glabrum* and *Mycelis muralis* were found during the rare plant surveys uniquely in dry gullies. Dry gullies were not mapped as a TEM unit but gullying was indicated by the use of the 'g' modifier on an ecosystem unit.

Closed-Canopy Douglas-Fir Forest

In the absence of disturbance, dense stands of conifers permanently shade the ground and cover the soil in acidic, nutrient-poor duff. Only a small subset of the plants native to British Columbia is able to withstand this dense shade and nutrient-poor soil. Though the plants found in understory of dense conifer forest are nearly all specialists to this habitat, the plant diversity found in the Project area under dense stands of Douglas-fir was low. Species found in the Project area uniquely within closed-canopy Douglas-fir forest include: *Antennaria racemosa, Goodyera oblongifolia, Linnaea borealis, and Pleurozium schreberi.* This habitat is typical of deer winter range. This habitat was mapped as the 01, 06 and 07 in the IDFxh2, and the 06 in the PPxh2.

Open-Canopy Douglas-Fir Forest

Far more plant diversity can occur in forests having a sparse canopy of conifers than in closed-canopy forest. The additional light that reaches the understory, and the thinner accumulation of acidic, low-nutrient conifer duff make this habitat less inhospitable to most plants. The threshold of canopy cover that excludes most plants from understory of closed-canopy forest varies with local climate, slope and aspect, but in the Project area, canopy cover of less than about 30% is non-inhibitive. Plant species found in the Project area only within open-canopy Douglas-fir forest are: *Anemone multifida, Antennaria anaphaloides, Antennaria parvifolia, Antennaria racemosa, Arthonia xerophila ined., Boechera grahamii, Bromus porteri, Calamagrostis rubescens, Chenopodium fremontii, Cladina arbuscula, Cladonia cariosa, Danthonia spicata, Descurainia incisa, Dracocephalum parviflorum, Elymus elymoides, Gentianella amarella, Lilium columbianum, Poa fendleriana, Shepherdia canadensis, Silene douglasii,* and *Spiraea lucida*. Raptors and woodpeckers frequently use this habitat. This habitat was mapped as the 02, 03 and 04 in the BGxh2, the 02 and 03 in the BGxw1 and IDFxh2, and the 01, 02 and 04 in the PPxh2.

Human-Disturbed Sites

Roadsides, tailings areas, heavily grazed sites, and other human-disturbed habitats are generally vegetated with invasive, often noxious weeds. Eurasian plants have adapted to thousands of years of intensive grazing, development and agriculture, and this history of coexistence with humans has selected for species that are tolerant of bare or compressed soils, frequent grazing, disrupted symbioses, and nitrogenous wastes and other pollution (**Plate 4-9**). Few of British Columbia's native species are adapted to growing in areas of such heavy human pressure on landscapes as is seen today around large population centres or in ranching areas. Large portions of the province's landscape are now converted to non-native vegetation, and this portion grows annually. Species found in the Project area only in human-disturbed sites include *Acroptilon repens, Agropyron cristatum, Bassia hyssopifolia, Bromus hordaceus, Centaurea diffusa, Dactylis glomerata, Kochia scoparia, Lappula echinata, Silene noctiflora* and *Trifolium hybridum*. All of these are exotic species. Other exotic species are capable of displacing native vegetation even without heavy disturbance from human activity. These include nearly all of the remaining exotic species found in the Project area (see **Appendix 8**). Barn Swallows nests may be found in anthropogenic features. Human-disturbed sites include the TEM map codes CF, ES, MI, MZ, RY, and RZ.

Plate 4-9 Disturbed Site with *Melilotus* (L. Andrusiak photo)

5.0 RARE PLANTS

5.1 Baseline

Surveys were timed to optimize plant identification (e.g., during flowering and/or fruiting) and occurred during the summers of 2007 to 2014. Survey efforts focused on sites where proposed infrastructure overlapped with likely rare plant habitat within the LSA. The collected data were analyzed in the office and lab between the field portions of the study.

5.2 Methods

For this study, "rare plants" were defined to include the following vascular plants, mosses, and lichens:

- species listed on Schedule 1 of the Canadian Species at Risk Act (SARA) as amended (Government of Canada 2002);
- species assigned a status of Extinct, Extirpated, Endangered, Threatened, or Special Concern by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2014); and
- species on the BC Ministry of Environment's provincial Red or Blue lists (BCMOE 2014).

A list of rare plant species known from the biogeoclimatic zones present in the study area was generated using the BC Species and Ecosystem Explorer (BC Conservation Data Centre 2014a). This list was refined based on the biogeoclimatic subzone and habitat types present in the project area as identified by the preliminary habitat mapping. The inclusion of taxa (i.e. species, subspecies, and varieties) on this list was based on known populations in the Kamloops area. Certain taxa were dropped from consideration due to the lack of suitable habitat in the project area. These all were either taxa of lower elevation habitats (along the shores of the Thompson River), or of higher elevation habitats than those present in the study area. Certain other species were added to the list in the case of taxa that would find suitable habitat in the area, but for which there are no known nearby populations. The final potential target rare plant species list is presented in **Appendix 4**, which includes 154 vascular plants, 26 mosses and 31 lichens.

The BC Resources Information Standards Committee (RISC) has not issued standards for conducting rare plant surveys, other than for the collection of voucher specimens (Resources Inventory Committee (RIC) 1999b). However, a number of organizations in North America have developed guidelines for these studies. The methods used for the Ajax Mine rare plant work are based on a synthesis of several of these guidelines (Bizecki-Robson 1998; Whiteaker et al. 1998; California Native Plant Society 2001; Henderson 2009; Alberta Native Plant Council 2012; Penny & Klinkenberg 2012).

Sites were surveyed on foot using an intuitive meander search pattern, staying primarily within habitats thought to contain the highest potential for rare plant occurrence. A representative cross-section of lower-probability habitats was also surveyed. Surveys typically were conducted by two botanists.

All vascular plant, moss, liverwort, and lichen taxa encountered within the project area were recorded. Species lists were kept for all transects surveyed (a transect here is defined as a single walking route conducted at each vehicle stop). Of particular focus during the surveys were the federal SARA Schedule 1 and COSEWIC Species of Concern mosses: Columbian carpet moss (*Bryoerythrophyllum columbianum*), rusty cord-moss (*Entosthodon rubiginosus*), nugget moss (*Microbryum vlossovii*), and alkaline wing-nerved moss (*Pterygoneuron koslovii*). All four of these species are known in the Kamloops area in habitats similar to those present in the project area.

The following references were consulted for vascular plant identification:

- ***Illustrated Flora of British Columbia*** Volumes 1-8 (Douglas et al. 1998a, 1998b, 1999a, 1999b, 2000, 2001a, 2001b, 2002),
- the ***Flora of the Pacific Northwest*** (Hitchcock & Cronquist 1973)
- published volumes of the ***Flora of North America*** (Flora of North America Editorial Committee. 1993, 1997, 2000, 2002, 2003, 2004; Flora of North America Editorial Committee 2005; Flora of North America Editorial Committee. 2006; Flora of North America Editorial Committee 2006a, 2006b; Flora of North America Editorial Committee. 2007; Flora of North America Editorial Committee 2007, 2009, 2010) and draft treatments for unpublished volumes)

- online databases (Klinkenberg 2006; BC Conservation Data Centre 2014a; NatureServe 2014); and
- additional species-specific taxonomic literature where available.

Moss, liverwort and lichen species were identified in the field, or laboratory based on

- Bryoflora of North America (2007, and draft treatments for unpublished volumes)
- *Moss Flora of the Pacific Northwest* (Lawton 1971)
- *Contributions toward a Bryoflora of California III* (Doyle & Stotler 2006)
- *The Lichens of British Columbia*, volumes 1 and 2 (Goward et al. 1994; Goward 1999)
- *Keys to Epiphytic Crust Lichens of British Columbia* (Björk unpublished)
- *Materials for an Epiphytic Crust Lichen Flora of Northwest North America* (Spribille 2006),
- and additional original taxonomic literature.

Consistent with both the RISC guidelines and rare plant survey guidelines on the BC E-Flora website (RIC 1999; Penny and Klinkenberg 2012) a voucher specimen was collected when doing so would not compromise the viability of the population. At least one specimen was collected for each of the rare plant taxa encountered. These were deposited at the University of British Columbia herbarium. Voucher photos (Plates 5-1 to 5-4) were also taken to record occurrences.

Data collected at each rare plant occurrence included at least one locality point (in the NAD83/UTM Zone 10N coordinate reference system) using Garmin® 62 and 72 GPS receivers. In addition, for the 2012 and 2014 surveys, the boundaries of all rare plant occurrences encountered were recorded using the GPS receivers. Element occurrence information was recorded regarding plant communities, soils, hydrology, canopy cover, population health, population size, phenology, and any special conservation concerns.

Collected data on all known rare plant occurrences in the project vicinity were compiled into a single, spatially enabled relational database (\\PostgreSQL Global Development Group 2012; Refractions Research 2012). Layers from the TEM mapping were imported. Base vector layers were obtained and added to the database from the BC Terrain Resource Information Management (TRIM) Program (BC Crown Registry and Geographic Base 2012). Colour relief hillshades were prepared from the 1:50,000 scale Canadian Digital Elevation Data (Natural Resources Canada 2012). The hillshade layers were added to serve as raster underlays.

The project rare plant spatial database was cross-referenced to two other non-spatial datasets to aid in the analysis. The first of these was the dataset of all BC plant species codes and selected attributes maintained by the Biogeoclimatic Ecosystem Classification (BEC) Program (BC Forest Service Research Branch 2012). The second cross-referenced dataset was the full attribute export from the BCCDC's Species and Ecosystems Explorer (BC Conservation Data Centre 2014a). This dataset served as the reference for the conservation statuses of the study area plants. Both cross-referenced datasets were downloaded and updated periodically throughout the course of the study to reflect the latest revisions.

5.3 Results

Over the six survey years (2007–2014), approximately 384 botanist hours were expended surveying the Ajax project area for rare plants (**Table 5-1**). A number of vegetative macrohabitats were identified in the project area during the rare plant surveys. These included sagebrush steppe, grassland, shores of ponds and lakes, submerged aquatic vegetation, creeks, gullies, saline/alkaline flats, vernal pools, aspen groves, shrub copses, Rocky Mountain juniper-hybrid spruce shrub wetlands, dry meadows, forested outcrops, sparsely vegetated outcrops, fine scree, talus, cliff underhangs, open- and closed-canopy Douglas fir forest, rock seeps, and human-disturbed sites. Rare plant survey tracks for all six years are presented in **Figure 5-1**.

Table 5-1 Survey Effort for Rare Plants

Year	Survey Dates	Total Time (hrs)
2007	various dates in May	approx. 48
2008	July 31, August 1	18
2010	August 20 to 26	40
2011	June 1 to 4, August 30 to September 2	66
2012	August 21 to 22	16
2014	June 18 to 25, August 9 to 13	196

Fifteen rare plant taxa were found during the six survey years. These include five vascular plants, two mosses, and eight lichens (**Table 5-2**). These 15 rare plant taxa were distributed in 26 total occurrences and those within the LSA are shown in **Figure 5-2**. One additional taxon was found during the surveys that is currently Blue-listed by the BCCDC: *Epilobium hallaneum* (Hall's willowherb). But at the time it was found, it was expected that the species would soon be de-listed by the BCCDC, and consequently no locational data was collected for the occurrence.

Table 5-2 Rare Plant Occurrences Found Within the Ajax LSA

Taxon	Common Name	BC List	SARA	COSEWIC	Occurrences[1]
VASCULAR PLANTS					
Atriplex truncata	Wedgescale Orache	Blue			1
Bouteloua gracilis	Blue Grama	Red			2
Hornungia procumbens	Ovalpurse	Blue			2
Orobanche ludoviciana var. *arenosa*	Suksdorf's Broomrape	Red			8
Stuckenia vaginata	Sheathing Pondweed	Blue			1
MOSSES					
Amblystegium varium	[no common name]	Blue			1
Pterygoneurum kozlovii	Alkaline Wing-nerved Moss	Blue	1-T	T	1
Stegonia latifolia var. *pilifera*	[no common name]	Red			1
LICHENS					
Collema crispum	Ten-Cent Tarpaper	Red			1

Taxon	Common Name	BC List	SARA	COSEWIC	Occurrences[1]
Dermatocarpon leptophyllodes	Jigsaw Stippleback	Blue			1
Fulgensia bracteata	Goldnugget Sulphur	Blue			1
Neofuscelia subhosseana	Erupting Toad	Blue			1
Peltula euploca	Powder-Lined Rock-Olive	Red			1
Phaeophyscia decolor	Lesser Eye Shadow	Blue			1
Physcia dubia	Grinning Rosette	Blue			3

[1] Total number of known occurrences within the LSA

In total, 681 plant and lichen taxa (species, subspecies, and varieties) were recorded within the Ajax RSA (**Appendix 8**). These include 491 vascular plants, 2 liverworts, 45 mosses, and 143 lichens. Many (114) of the plants are also collected by First Nations for a variety of traditional uses (**Appendix 8**).

All of the lichen species found during field surveys are native to BC, while two moss taxa and 112 (23%) of the vascular plants are exotic; introduced to the study area by human activity. Exotics tend to displace native species where human-caused disturbances are heavy and/or frequent. The spread of non-native species has been ranked as one of the most serious threats to biodiversity and ecosystem health (Wilson 2001). Two exotic species found in the project area are new to the BC flora, ditch beardgrass (*Polypogon interruptus*) and smallflower tamarisk (*Tamarix parviflora*). The latter of these two is not only a new species to the list of known naturalized exotic species of BC, but its genus and family are also new additions.

Rare Plant Habitats

TEM habitats surveyed during rare plant surveys include numerous site series of the BGxw1 and IDFxh2 biogeoclimatic variants. In the BGxw1 subzone, site series surveyed include the Ro01 and Ro02 rock outcrop habitat types, Gs01 (saline meadow), the 81 and 81ls grassland types, and the 02, 03, 04, and 05 forest types. In the IDFxh2 subzone, variants surveyed include the 72 (talus), 73 and 02 rock outcrop, the 03, 04 and 05 dry forest, the 01, 06 and 07 forest types, and the 10-YS aspen forest habitat types

Sparsely vegetated, non-forested habitats that permanently inhibit dense tree and shrub growth (various non-forested wetlands and shorelines, grassland, shrub steppe, scree, and rock outcrops) are vital habitat for most of the native plants of British Columbia, as well as many of the mosses and lichens. The macrohabitats identified in the Project area are described in Section 4.3.

One rare lichen currently under consideration for COSEWIC listing (but not in the CDC database, *Buellia elegans*), and a Blue-listed lichen, *Fulgensia bracteata,* were found in sagebrush steppe habitat.

Four rare taxa were found in grasslands during surveys: *Bouteloua gracilis* (vascular plant), *Orobanche ludoviciana* (vascular plant), *Collema crispum* (lichen), and *Stegonia pilifera* (moss).

Two rare vascular plants, *Atriplex truncata* and *Hornungia procumbens*, and a rare moss, *Pterygoneurum kozlovii*, were found in or on margins of saline wetlands. *Amblystegium varium* was collected from a pond edge habitat. The Blue-listed *Stuckenia vaginata* was found in standing open water associated with marsh habitats.

The Blue-listed lichen, *Dermatocarpon leptophyllodes* and the Red-listed lichen, *Peltula euploca* were found in sparsely vegetated outcrop habitat. *Neofuscelia subhosseana* and *Physcia dubia* also grow on rock surfaces.

Forested outcrops were occupied mostly by a few, hyperdominant moss species including *Pheophyscia decolor* which is Blue-listed.

No rare species were found in Douglas-fir forest due to dense shade and nutrient-poor soil.

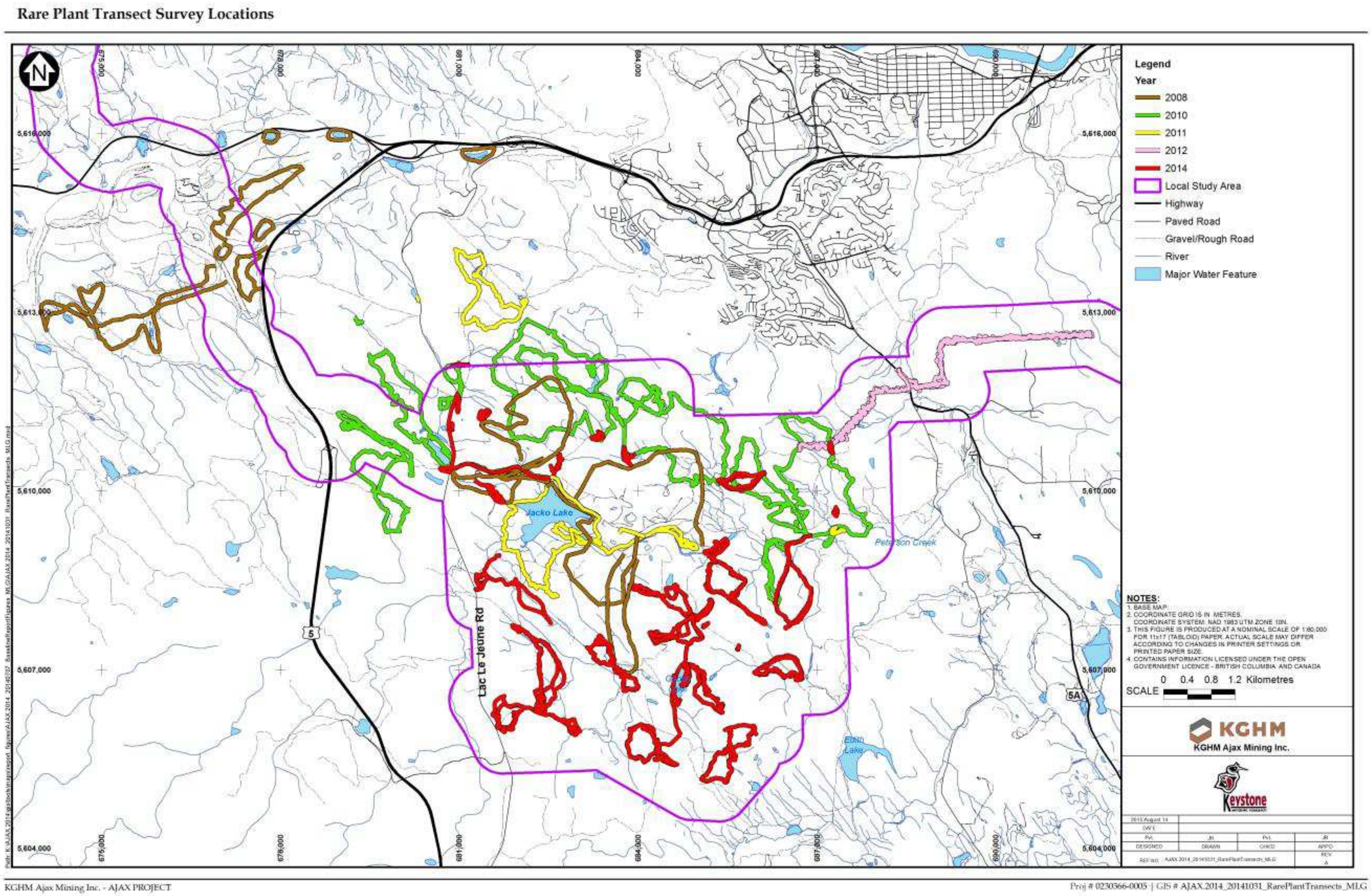


Figure 5-1 Rare Plant Transect Survey Locations

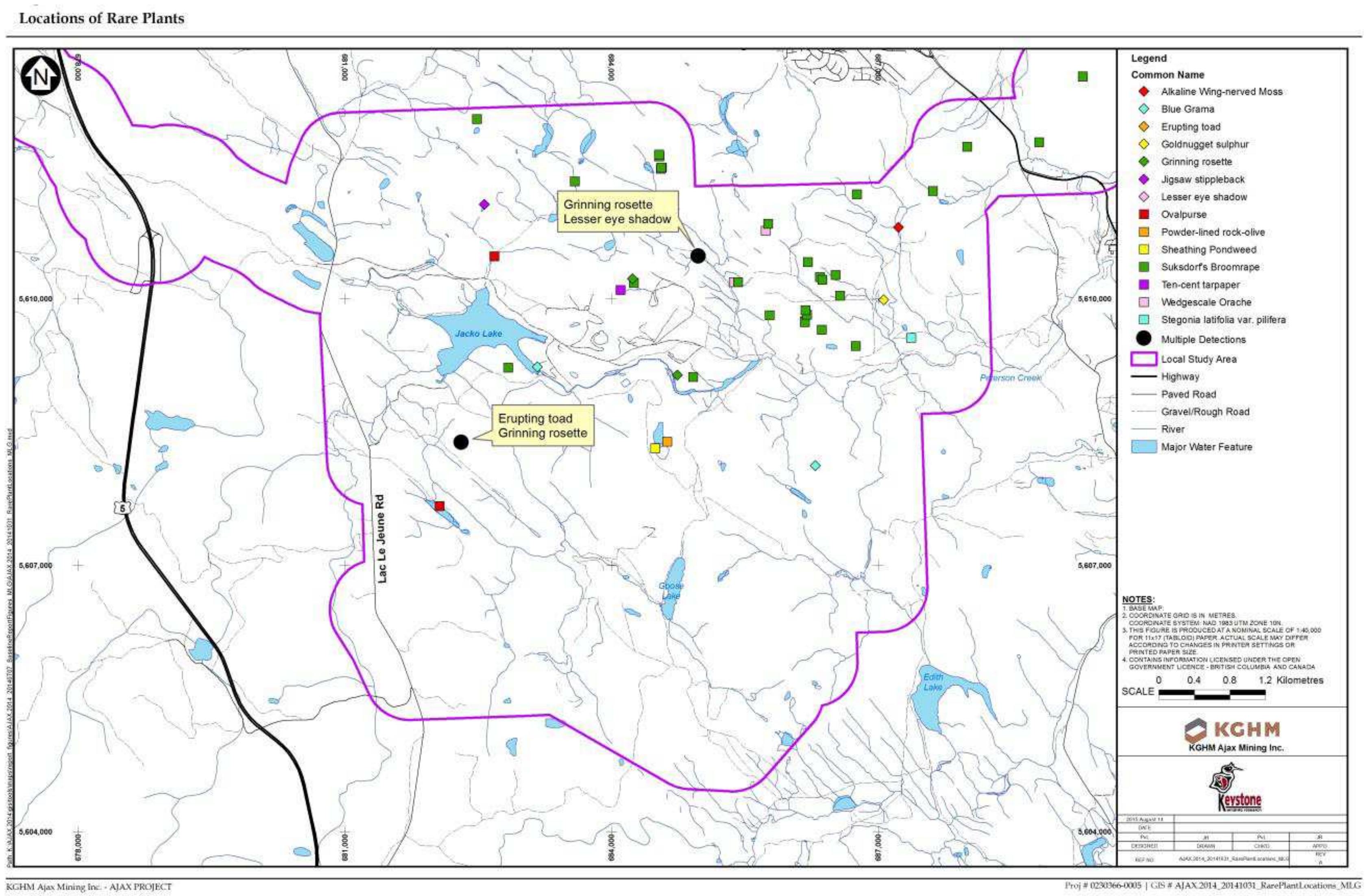


Figure 5-2 Locations of Rare Plants

Rare Plant Species Descriptions

***Atriplex truncata* Wedgescale orache (Blue-listed**). Wedgescale orache is a tall annual of the Chenopodiaceae (goosefoot family). The species has numerous diamond-shaped leaves and can grow up to one metre in height (**Plate 5-1**Error! Reference source not found.). All parts of the plant are covered in silver scales and have a metallic sheen. The minute flowers are enclosed in conspicuous wedge-shaped bracts (Douglas et al. 1998b; Welsh 2007). Wedgescale orache is found in saline habitats in limited areas of temperate western North America, from BC east to Saskatchewan, south to California and New Mexico; but few sites are reported in Canada (Welsh 2007; BC Conservation Data Centre 2014a; NatureServe 2014). In British Columbia, wedgescale orache is known only from the driest portions of the Central Interior, from the Chilcotin Grasslands to the U.S. border (BC Conservation Data Centre 2014a). One occurrence of wedgescale orache was found in the northeast section of the LSA, north of Peterson Creek. The species appears to be somewhat tolerant of disturbance, as it was observed occupying old jeep tracks and competing well with invasive species (**Figure 5-2**).

Plate 5-1 Wedgescale Orache (C. Bjork photo)

***Bouteloua gracilis* (blue grama) (Red-listed):** Blue grama (**Plate 5-2**) is a densely-tufted perennial grass that grows 10–50 centimetres tall, usually bearing two showy, purplish blue spikes (Fontaine & Douglas 1999). This member of the Poaceae (grass family) is the only species of its genus in BC and reaches the northwestern limit of its range here (Douglas et al. 2001b; Wipff 2003). Blue grama is a common dominant species of the North American short grass prairie, which extends from BC east to Manitoba and the eastern United States, and south to Mexico. In these regions, the species grows in open grassland of various types (Wipff 2003). In British Columbia, blue grama is known only from a few sites in the Fraser River basin and in the southern part of the Rocky Mountain trench, and is restricted to pockets of dry lands bounded by forested ridges (Fontaine & Douglas 1999). Overgrazing, fire suppression, expanding development, and invasive plant species pose significant threats to this taxon (Fontaine & Douglas 1999). Blue grama was observed at two locations in the LSA: southeast of Jacko Lake, and near the east-central border of the study area (**Figure 5-2**).

Plate 5-2 Blue Grama (C. Bjork photo)

Epilobium halleanum **(Hall's willowherb) (Blue-listed):** Hall's willowherb is a perennial vascular plant in the Onagraceae (evening-primrose family). Its slender, erect stems grow from a rhizome attached to small underground bulblets. The species has small pink or white flowers and long, slim fruiting capsules. Numerous tiny seeds are produced, each of which bears a delicate tuft of white hair at one end. Hall's willowherb is found across western North America, in various montane habitats such as open forests, moist slopes, and wet meadows (Cronquist et al. 1997; Douglas et al. 1999b; NatureServe 2014). In BC, the taxon is documented from a number of sites in the southern interior regions of the province (BC Conservation Data Centre 2014a). Observations of Hall's willowherb populations were reported from the study area in 2008 east of Inks Lake.

Hornungia procumbens **(ovalpurse) (Blue-listed):** Ovalpurse is a diminutive annual vascular plant of the Brassicaceae (mustard family). The taxon has thin, spreading branches that terminate in an elongated inflorescence of tiny white flowers; the flattened, obovoid-shaped fruits have a prominent network of nerves over the surface (Al-Shehbaz 2002; Cheo et al. 2008). Ovalpurse has a very broad distribution in temperate regions of the Northern Hemisphere, and has also been introduced into Mexico, S. America, S. Africa, and Australia (Al-Shehbaz 2002). However, the species is irregularly distributed and rare across Canada and in BC (Al-Shehbaz 2002; BC Conservation Data Centre 2014a; NatureServe 2014). Ovalpurse grows in moderately to strongly saline soil in arid and semi-arid regions (Al-Shehbaz 2002). In British Columbia the taxon is threatened primarily by habitat loss and livestock grazing (BC Conservation Data Centre 2014a). Ovalpurse was found in two locations in the Ajax LSA: north of Jacko Lake in an intermittent stream course, and along the shoreline of a pond near the west-central border (**Figure 5-2**).

Orobanche ludoviciana **var.** ***arenosa*** **(Suksdorf's broomrape) (Red-listed):** Suksdorf's broomrape is a small parasitic vascular plant of the Orobanchaceae (Broomrape family). The taxon's roots are coarse and fleshy, and its stout, purplish stem bears short-stalked pinkish flowers in a dense spike (**Plate 5-33).** Suksdorf's broomrape generally parasitizes plants of the Asteraceae (sunflower family), particularly species of *Artemisia* (sage) (Douglas et al. 1999a). The species as a whole ranges across much of west-central North America (NatureServe 2014), but several subdivisions have been delineated of which two varieties are recognized by the BCCDC (M. Donovan pers. comm. 2013). The BCCDC reports variety *ludoviciana* from locations in southeast BC, and variety *arenosa* from sites near Kamloops (BC Conservation Data Centre 2014a). Eight occurrences of Suksdorf's broomrape var. *arenosa* were recorded across the central and northeastern sections of the Ajax LSA (**Figure 5-2**).

Plate 5-3 Suksdorf's Broomrape (C. Bjork photo)

Stuckenia vaginata **(sheathing pondweed) (Blue-listed):** Sheathing pondweed is a perennial aquatic vascular plant belonging to the Potamogetonaceae (horned pondweed family). The taxon's slender, freely-branching stems extend from 20 to 120 centimetres in length; each linear, thread-like leaf bears an inflated sheath at the base of the leaf stalk. The small fruits of sheathing pondweed are rounded and beakless (Douglas et al. 2001b; Les & Haynes 2007). The species is found submerged in shallow to deep ponds and lakes in northern regions of the northern hemisphere (Les & Haynes 2007; BC Conservation Data Centre 2014a; NatureServe 2014). Occurrences of sheathing pondweed are known from throughout the province, particularly from central BC both east and west of the Rocky Mountains (BC Conservation Data Centre 2014a). The taxon is sensitive to changes in water quality, and is threatened by water pollution from mining and agriculture. Other threats include shoreline development, invasive exotic plant species, and changes in hydrology (NatureServe 2014). Sheathing pondweed was observed in a pond near the centre of the LSA (**Figure 5-2**).

Amblystegium varium **(willow feather-moss) (Blue-listed):** Willow feather-moss, also known as *Hygroamblystegium varium*, is a delicate, irregularly branched moss of the Amblystegiaceae (Amblystegium family). The taxon bears minute, horizontally-held capsules atop relatively long, reddish stalks. Willow feather-moss generally forms loose, thin mats in wet sites on mineral soils and decaying vegetation (Vanderpoorten 2009; Atherton et al. 2010; University of California Herbarium 2014). The taxon is highly variable in form, and is found world-wide in a variety of mesic to aquatic habitats (Vanderpoorten 2009). Willow feather-moss occurrences are known from Central and Southwest BC (BC Conservation Data Centre 2014a). The specimen was collected in the LSA by the edge of a pond to the west of Jacko Lake (**Figure 5-2**), and tentatively identified as willow feather-moss. Further investigation is ongoing to confirm the identification.

***Pterygoneurum kozlovii* (alkaline wing-nerved moss) (Blue-listed, SARA-listed Threatened):** Alkaline wing-nerved moss is a tiny clump-forming perennial of the Pottiaceae (pottia family). The species' short, yellow-green leaves are two to three millimetres long, with minute longitudinal flaps on the upper surface of the midvein. The spore capsule of alkaline wing-nerved moss is globose, and unlike the capsules of most mosses, it remains immersed in the leaf rosette and lacks any regular opening: instead the capsule wall breaks apart irregularly by tears or abrasions that form gradually with age (British Columbia Bryophyte Recovery Team (BCBRT) 2009; BC Conservation Data Centre 2014a). The taxon grows on soil at the margins of alkaline wetlands, and is known from disparate sites in western North America and Eurasia (McIntosh 1986; COSEWIC 2004a). In BC, alkaline wing-nerved moss has been documented in scattered locations across the southern part of the province (BC Conservation Data Centre 2014a). Threats to the specialized habitat of this moss include overuse by livestock, urban and highway development, recreational use, and drought (COSEWIC 2004a; BC Conservation Data Centre 2014a). Alkaline wing-nerved moss was found near the edge of a pond in the northeast corner of the LSA (**Figure 5-2**).

***Stegonia latifolia* var. *pilifera* (stegonia moss) (Red-listed):** Stegonia moss variety *pilifera*, also known as *Stegonia pilifera*, is a member of the Pottiaceae (pottia family). The small mosses included in the genus *Stegonia* are distinctive for two reasons: the cells of the leaf walls are thicker on the side facing outward than on the side facing toward the plant centre, and the tips of the leaves are pale and lacking in chlorophyll. The minute spore capsules of *Stegonia latifolia* sit atop relatively long stalks, which are well exerted from the tiny, bulb-like stem bases. In contrast to the typical variety *latifolia*, the leaves of var. *pilifera* are generally tipped by a hair-like awn (Zander 2007).

Stegonia moss is found growing on soil and rock in tundra and arctic alpine locations across the northern hemisphere (Zander 2007; NatureServe 2014). In North America, var. *pilifera* is found in the arctic regions of Canada, and in moderate to high-elevation sites in BC, Alberta, Manitoba, Colorado and California (Zander 2007). In BC, the taxon is known from the far northeast region of the province (BC Conservation Data Centre 2014a). Within the study area, stegonia moss var. *pilifera* was observed on soil at the mouth of a badger hole near the northeast border of the LSA (**Figure 5-2**).

***Collema crispum* (ten-cent tarpaper) (Red-listed)**: While most lichens are a symbiosis of a fungus and a green alga, this lichen is a symbiosis of a fungus and cyanobacteria; a so-called 'cyanolichen'. Cyanobacteria, being photosynthetic, are able to fill the same role as a green alga in the lichen symbiosis. Cyanolichens are on average more sensitive to environmental conditions than are the green algal lichens, owing to higher pollution sensitivity and narrower ranges of suitable pH and moisture-temperature interactions. As with most soil-dwelling lichens, ten-cent tarpaper is sensitive to overgrazing. Remaining populations in British Columbia are in sites that either have not received heavy grazing pressure, or are in microsites that are avoided by cattle. Invasive plant species may also bear an impact on this species, owing to the smothering thatch formed by weedy introduced grasses and forbs. Ten-cent tarpaper is easily recognized among *Collema* species in having isidia (detachable outgrowths of the thallus that function as dispersal units) that are flattened rather than round (Goward et al. 1994). It grows on rock and, especially, soil in open, dry habitats, mostly in grassland. Ten-cent tarpaper is widely distributed around the northern hemisphere, but is nowhere common. In British Columbia the taxon is known from eight populations: in the Okanagan Valley, the Chilcotin and the Thompson Plateau. This species was found in the north-central area of the LSA (**Figure 5-2**).

***Dermatocarpon leptophyllodes* (jigsaw stippleback) (Blue-listed):** This lichen is unusual within its genus in its semi-crustose rather than foliose habit, scarcely lifting from the rock surfaces it grows on, but instead forming a mosaic of mounded areoles 2–4 millimetres wide crowded into patches up to 80 millimetres across. The exposed surface of the thallus is pale gray-brown, covered in a thin layer of dead cortical cells. The spores are produced in round chambers (perithecia) embedded within the thallus, and the blackish stippling visible on the upper thallus surface corresponds to the numerous, tiny perithecial openings through which the spores are ejected (Goward et al. 1994). In British Columbia, jigsaw stippleback is found in few sites scattered through the Southern Interior, and from there it is distributed south sporadically and rarely to California, and rarely also in northwestern Europe (Heiömarsson 2000). The species is found on firm, slow-eroding rock faces, mostly with a neutral pH, but sometimes on alkaline rock such as limestone. Jigsaw stippleback was found at one site in the northwest section of the LSA (**Figure 5-2**).

***Fulgensia bracteata* (goldnugget sulphur) (Blue-listed):** This lichen is one of few soil-dwelling species having a conspicuous yellow-orange thallus. Its bright anthraquinone pigments are characteristic of most of the members of its family, the Teloschistaceae, which are easily recognized not only by their colour, but by their striking colour change to purple when exposed to potassium hydroxide (McCune & Goward 1995). *Fulgensia* is a genus of desert, tundra and dry-grassland species (McCune & Goward 1995). Most members of the genus form lobed thalli, with the lobes set atop a felt-like mat of pale fungal hyphae. The apothecia of *Fulgensia* species are typically dark orange, as is true of goldnugget sulphur (McCune & Goward 1995). A similar-looking member of the Teloschistaceae, *Caloplaca tominii* is more common in the project area and grows in similar habitats. It differs in being non-lobate, lacking the felty mat subtending the lobes, and in its bearing soredia (dust-like vegetative propagules).

Goldnugget sulphur is distributed widely in the northern hemisphere (McCune and Goward 1995), but is nowhere abundant. In British Columbia, the taxon is found in the Thompson Plateau, Chilcotin Grasslands and the Peace River Grasslands. It favours calcareous soil (McCune & Goward 1995), or lower-pH soil that is modified by wind-blown accumulations of calcareous dust. This species, as with so many that are soil-dwelling in grasslands, appears to be sensitive to overgrazing and other human-caused disturbances. *Fulgensia* requires a stable soil veneer in sparsely vegetated sites. That veneer is easily destroyed by trampling cattle, and overgrazing often results in the spread of dense patches of thatch-forming invasive plants that may smother soil-dwelling lichens or increase fire frequency and intensity. Goldnugget sulphur was found near the northeast corner of the LSA (**Figure 5-2**).

***Neofuscelia subhosseana* (erupting toad) (Blue-listed):** This lichen is a member of a large genus found mostly in dry climates in the southern hemisphere. All three species of the genus that occur in British Columbia are currently tracked by the BC CDC. Erupting toad grows in desert, grassland, shrub steppe, and savannah, where it occupies acidic rock surfaces. It is characterized by having a glossy, dark brown upper surface, rosettes of radiating lobes, globose isidia (detachable outgrowths of the thallus that function as dispersal units) that are scattered or loosely bundled, and a distinctive set of chemical spot-tests (Goward et al. 1994). It is currently known from three populations in the province, one each in the Okanagan Valley, Thompson Plateau, and Chilcotin Grasslands. Despite its apparent rarity, it is given a lower ranking priority owing to the security of its habitat. It grows on rock surfaces where it is less sensitive to effects of human-caused disturbances. This species was located south of Jacko Lake in the west-central section of the LSA (**Figure 5-2**).

***Peltula euploca* (powder-lined rock-olive) (Red-listed):** The lichen genus *Peltula* is found mostly in desert regions and is an oddity among lichens in having as its photosynthetic partner the cyanobacterium *Anacystis*. In BC, it is known only from six sites in two small clusters of three populations each, one along the Fraser River in the Chilcotin, and the other in the southern Okanagan. The population reported here is the first from the Kamloops area, and is the only one thus far in BC found to be fertile (spore-bearing). Powder-lined rock-olive grows on dry or seepy rock faces in dry climates (Goward et al. 1994). The rock type may be acidic or pH-neutral. This species was found on the rock outcrop near the center of the LSA (**Figure 5-2**).

***Phaeophyscia decolor* (lesser eye shadow) (Blue-listed):** This lichen species is characterized by its grey-green rosettes of narrow lobes (0.2–0.5 millimetres wide), with a dark brown to black lower surface. It is a normally fertile species, lacking vegetative reproduction, but bearing spore-forming apothecia instead. *Phaeophyscia ciliata* is similar, but with broader lobes (0.4–1.5 millimetres wide), and normally grows on bark rather than on rock. Habitats occupied are mostly basalt boulders and promontories, usually where nutrient-enriched by birds where they frequently perch and defecate. In the project area, lesser eye shadow was found on mosses over rock, without the guano-enrichment element normally found in its habitat. In British Columbia, this species ranges rarely through the central Interior, south to the western U.S. and northwest Mexico. It also is sporadically distributed through Eurasia. Changes to populations of perching birds could alter the habitat usually occupied by this species. This lichen was found in the north-central section of the LSA (**Figure 5-2**).

***Physcia dubia* (grinning rosette) (Blue-listed):** This lichen species is identified based on its pale to medium gray, waxy or slightly glossy upper surface, presence of soredia (dust-like outgrowths of the thallus interior that function as dispersal units) at the lobe tips, negative reaction to potassium hydroxide in the medulla (thallus interior), and its small size and weakly rosette-forming growth (**Plate 5-4**). It is highly variable and may include one or more additional forms yet to be split out as distinct species. It grows on rock, usually on surfaces of underhangs, where it can be sheltered from direct rain-splash, and where nutrient-rich dust can accumulated without being washed away by rain water. The sites it occupies are also characterized by being nitrogen-enriched by bird guano or rodent droppings.

Grinning rosette has a wide global range and may be locally common (Goward et al. 1994). It is known currently from 19 populations in British Columbia, scattered from northwestern portions of the province, in the Chilcotin, Thompson Plateau, Coast Ranges, and Okanagan Valley. Despite its wide geographical extent in the province, it is rarely seen. With its requirement for nitrogen enrichment from birds and rodents, it may have an extra degree of environmental sensitivity. Also, it is likely to be sensitive to air pollution. Three occurrences of grinning rosette were identified in the LSA: one in the north-central section, one near the centre, and one in the west-central area (**Figure 5-2**).

Plate 5-4 Grinning Rosette (C. Bjork photo)

Noxious Weeds and Invasive Species

During the 2014 rare plant surveys, BC noxious weed occurrences were also recorded when they were encountered in the field. Eleven noxious weed species were found, in a total of 209 occurrences (**Table 5-3**). Many of the occurrences were large; covering several hectares (**Plate 5-5**). It should be noted that the 2014 surveys were not an exhaustive inventory of all noxious weed infestations within the LSA, and additional occurrences may be present.

Table 5-3 Noxious Weeds Recorded in the LSA During 2014 Surveys

Taxon	Common Name	Total Sites	Total Area (m^2)
Centaurea stoebe ssp. micranthos	Spotted Knapweed (SK)	59	152,944
Cynoglossum officinale	Common Hound's-tongue (HT)	57	32,111
Cirsium arvense	Canada Thistle (CT)	42	86,088
Arctium minus	Common Burdock (BU)	18	83
Sonchus arvensis	Perennial Sow Thistle (PS)	10	32,246
Leucanthemum vulgare	Oxeye Daisy (OD)	9	331
Linaria genistifolia ssp. dalmatica	Dalmatian Toadflax (DT)	5	5,026
Potentilla recta	Sulphur Cinquefoil (SC)	3	45
Cardaria sp.	Hoary Cress (HC)	2	120

Centaurea diffusa	Diffuse Knapweed (DK)	2	10,020
Acroptilon repens	Russian Knapweed (RK)	2	600

Diffuse knapweed, spotted knapweed and Dalmatian toadflax are the most prevalent noxious weeds on grasslands throughout the Thompson Basin (Wikeem and Wikeem 2004). There are also mapped occurences of Hoary alyssum (*Berteroa incana*) along Goose Lake Road (IAPP).

Plate 5-5 Knapweed Infestation (T. Kohler photo)

While many of these BC-listed noxious weeds are truly aggressive in the project area, other exotic species may be equally or more damaging to habitats in the project area. These include cheatgrass (*Bromus tectorum*), prickly lettuce (*Lactuca serriola*), reed canarygrass (*Phalaris arundinacea*), rabbitfoot polypogon (*Polypogon monspeliensis*), and Loesel's tumble-mustard (*Sisymbrium loeselii*). These species are widely recognized among botanists and ecologists as among the worst weeds in the dry interior of BC, but several additional species threaten native plant diversity in the region, though they are not often discussed as problem species: crested wheatgrass (*Agropyron cristatum*), creeping bentgrass (*Agrostis stolonifera*), thyme-leaved sandwort (*Arenaria serpyllifolia*), pale alyssum (*Alyssum alyssoides*), quackgrass (*Elymus repens*), black medic (*Medicago lupulina*), alfalfa (*Medicago sativa*), white sweet-clover (*Melilotus alba*), yellow sweet-clover (*Melilotus officinalis*), and Kentucky bluegrass (*Poa pratensis* ssp. *pratensis*). Some of these latter species are favoured as forage for cattle or as components of revegetation seed mixes, but their displacement of native vegetation and threat to biodiversity and landscape visual quality should also be considered. Large portions of BC's grassland and sagebrush steppe have been degraded by these and other exotic species.

6.0 RARE ECOLOGICAL COMMUNITIES AND SENSITIVE ECOSYSTEMS (EXCLUDING GRASSLANDS)

6.1 Baseline

Rare and sensitive ecological communities and habitats are defined as wetlands, old-growth forests, rock outcrops, and listed Ecological Communities at Risk (ECAR). Grasslands are also sensitive ecosystems but are discussed as a separate VC (see **Section 7.0**84). Ecological communities at risk are defined and tracked by the BC Conservation Data Centre (2014a). ECARs are usually (but not always) correlated with site series defined within the provincial biogeoclimatic zone system. The ECARs defined for the subzone variants within the LSA have been correlated with the site series defined in the older Kamloops regional site series guide (Lloyd et al. 1990), but have not been officially correlated with the updated draft site series guide that was used in the TEM mapping for the Project. A draft correlation with the TEM units and the ECARs was prepared, and Regional Ecologist and ecologists at the BC Conservation Data Centre provided input into the correlation (**Table 6-1**). Note that not all of the site series listed in **Table 6-1** were mapped in the LSA. Two communities, water birch / roses and alkali saltgrass Herbaceous Vegetation, are listed under the Identified Wildlife Management Strategy (BC Ministry of Water, Land and Air Protection 2004).

Table 6-1 Ecological Communities at Risk (Excluding Grasslands) and Their Correlation with Site Series

Scientific Name	English Name	Identified Wildlife	BC List*	Conservation Framework Highest Priority	Associated Site Series		
					BGxw1	PPxh2	IDFxh2
Betula occidentalis / Rosa spp.	water birch / roses	Yes	Red	1	n/a	Fl30	n/a
Distichlis spicata var. stricta Herbaceous Vegetation	alkali saltgrass Herbaceous Vegetation	Yes	Red	not ranked	Gs01	Gs01	Gs01
Pinus ponderosa / Pseudoroegneria spicata	ponderosa pine / bluebunch wheatgrass	No	Blue	2	02	04	n/a
Pinus ponderosa / Pseudoroegneria spicata - Festuca campestris	ponderosa pine / bluebunch wheatgrass - rough fescue	No	Red	2	03	01	n/a
Populus balsamifera ssp. trichocarpa - Betula occidentalis	black cottonwood - water birch	No	Red	1	n/a	07	n/a

Scientific Name	English Name	Identified Wildlife	BC List*	Conservation Framework Highest Priority	Associated Site Series		
					BGxw1	PPxh2	IDFxh2
Populus tremuloides / Symphoricarpos albus / Poa pratensis	trembling aspen / common snowberry / Kentucky bluegrass	No	Red	2	05	n/a	10YS
Pseudotsuga menziesii - Pinus ponderosa / Calamagrostis rubescens	Douglas-fir - ponderosa pine / pinegrass	No	Blue	2	n/a	n/a	01
Pseudotsuga menziesii - Pinus ponderosa / Pseudoroegneria spicata	Douglas-fir - ponderosa pine / bluebunch wheatgrass	No	Red	2	n/a	n/a	02
Pseudotsuga menziesii - Pinus ponderosa / Pseudoroegneria spicata - Calamagrostis rubescens	Douglas-fir - ponderosa pine / bluebunch wheatgrass - pinegrass	No	Blue	2	n/a	n/a	04
Pseudotsuga menziesii / Symphoricarpos albus - Amelanchier alnifolia	Douglas-fir / common snowberry - saskatoon	No	Red	2	n/a	06	n/a
Typha latifolia Marsh	common cattail marsh	No	Blue	1	Wm05	Wm05	Wm05
Salix exigua Shrubland	narrow-leaf willow Shrubland	No	Red	2	Fl06	n/a	n/a
Thuja plicata - Pseudotsuga menziesii / Cornus stolonifera	western redcedar - Douglas-fir / red-osier dogwood	No	Blue	2	n/a	n/a	09
Populus balsamifera ssp. *trichocarpa / Symphoricarpos albus - Rosa* spp.	black cottonwood / common snowberry - roses	No	Red	1	Fm01 (06)	n/a	n/a
Carex atherodes Fen - Marsh	awned sedge Fen - Marsh	No	Red	2	Wm03	n/a	n/a
Juncus balticus - Potentilla anserina	Baltic rush - common silverweed	No	Red	2	Wm07	n/a	n/a

Scientific Name	English Name	Identified Wildlife	BC List*	Conservation Framework Highest Priority	Associated Site Series		
					BGxw1	PPxh2	IDFxh2
Schoenoplectus acutus Deep Marsh	hardstemmed bulrush deep marsh	No	Blue	4	Wm06	Wm06	Wm06
Salix bebbiana / Calamagrostis canadensis	Bebb's willow / bluejoint reedgrass	No	Blue	3	Ws03	n/a	n/a

*as of September 2014

6.2 Methods

The TEM methodology was standard and included both aerial photo interpretation and field-truthing (see Section 4.3). Assessment of rare and sensitive ecological communities and habitats was done by theming the ecosystem map to identify polygons where any of the site series correlated with those habitats were mapped (any decile). Old-growth forest was quantified by summing the area of TEM mapped as structural stage 7.

6.3 Results

A summary of all ecosystems mapped in the TEM is presented in **Appendix 3**. Summaries of ECARs and sensitive ecosystems are presented below.

Ecological Communities at Risk

A number of site series correlated with ecological communities at risk (ECAR; **Appendix 5**) were mapped on the TEM map within the LSA. **Table 6-2** summarizes the mapped areas of each non-grassland site series associated with a listed community. In total, approximately 1291 ha of site series associated with ECAR were mapped in the LSA. Much of this is due to the 700 ha of the 01 site series mapped in the IDFxh2.

Table 6-2 Site Series Correlated With Ecological Communities at Risk Mapped within the LSA (excluding grasslands)

Biogeoclimatic Subzone Variant	Site Series	ECAR Correlation	Provincial List	Total Mapped in LSA (ha)
BGxw1	03	ponderosa pine / bluebunch wheatgrass - rough fescue	Red	5.4
BGxw1	05	trembling aspen / common snowberry / Kentucky bluegrass	Red	11.7
BGxw1	Gs01	alkali saltgrass Herbaceous Vegetation	Red	5.6
BGxw1	Wm05	common cattail marsh	Blue	8.0
IDFxh2	01	Douglas-fir - ponderosa pine / pinegrass	Blue	699.2

Biogeoclimatic Subzone Variant	Site Series	ECAR Correlation	Provincial List	Total Mapped in LSA (ha)
IDFxh2	02	Douglas-fir - ponderosa pine / bluebunch wheatgrass	Red	70.7
IDFxh2	04	Douglas-fir - ponderosa pine / bluebunch wheatgrass - pinegrass	Blue	79.4
IDFxh2	09	western redcedar - Douglas-fir / red-osier dogwood	Blue	24.4
IDFxh2	10	trembling aspen / common snowberry / Kentucky bluegrass	Red	93.2
IDFxh2	Gs01	alkali saltgrass Herbaceous Vegetation	Red	2.6
IDFxh2	Wm05	common cattail marsh	Blue	12.2
IDFxh2	Wm06	hardstemmed bulrush deep marsh	Blue	10.9
PPxh2	01	ponderosa pine / bluebunch wheatgrass - rough fescue	Red	196.4
PPxh2	04	ponderosa pine / bluebunch wheatgrass	Blue	55.1
PPxh2	06	Douglas-fir / common snowberry - saskatoon	Red	13.4
PPxh2	Gs01	alkali saltgrass Herbaceous Vegetation	Red	3.1

Listed wetland ecosystems mapped in the LSA include the Red-listed Gs01 alkali saltgrass Herbaceous Vegetation (*Distichlis spicata* var. *stricta* Herbaceous Vegetation), the Blue-listed common cattail marsh (*Typha latifolia marsh*) and the Blue-listed hardstemmed bulrush deep marsh. Saline meadows were mapped as the Gs01 ecosystem in the TEM. The saltgrass saline meadow unit was mapped as scattered polygons in all subzones. It may include permanent or temporary open water, which is generally alkaline or saline (MacKenzie & Moran 2004). The water attracts cattle, especially in hot weather, and the Gs01 ecosystems in the study area are moderately to heavily affected by trampling, manure, and invasive plant species. Gs01 ecosystems and their associated ponds provide breeding habitat for Great Basin spadefoot and may also be used by western toads, although the standing water may not always remain present long enough for amphibians to complete their life cycle.

The common cattail marsh is a widespread rich wetland ecosystem found across the province (BC Conservation Data Centre 2014a). Common cattail (*Typha latifolia*) is the dominant vegetation species. It provides habitat for amphibians, waterfowl, beaver, muskrat, dragonflies, and a wide variety of passerine birds.

The hard-stemmed bulrush marsh is also widely distributed and generally occurs in small patches (BC Conservation Data Centre 2014a). This marsh also provides habitat for amphibians, waterfowl, beaver, muskrat, dragonflies, and a wide variety of passerine birds.

Listed aspen grove ecosystems include the trembling aspen / common snowberry / Kentucky bluegrass community (*Populus tremuloides* / *Symphoricarpos albus* /*Poa pratensis*), which is Red-listed.

The aspen groves of the LSA are used by cattle for shelter and as a result tend to be well-trampled, especially when they occur close to water sources.

One Red-listed and one Blue-listed ECARs of ponderosa pine forests are correlated with the 01 and 04 in the PPxh2 and the 03 in the BGxw1. Large ponderosa pine are now rare in the LSA due to pine beetle attack and ponderosa pine ecosystems are now characterized by sparse cover of young trees that have escaped the epidemic.

Listed Douglas-fir ECARs are correlated with the 01, 02 and 04 in the IDFxh2, and the 06 in the PPxh2. The 01 and 04 are mesic forest ecosystems in the IDFxh2 and so were very commonly mapped. The IDFxh 09 forest was mapped occasionally in moist forested areas.

Sensitive Ecosystems

Other sensitive ecosystems were defined as wetlands, alkali ponds, riparian habitat, rock outcrops and old-growth forest. These are described below.

<u>Wetlands</u>

Wetlands mapped within the LSA within the TEM totalled approximately 221 ha and include lakes, ponds, alkaline wetlands, marshes and willow swamps (**Table 6-3**). Roughly 42 permanent and intermittent wetlands were identified within the LSA during field surveys (**Figure 6-1**), although this is an approximate number and does not include some temporary/intermittent water features. That total number also does not include the named lakes (Jacko Lake, Inks Lake, Wallender Lake, Goose Lake and Kamloops Lake) that are partially or wholly within the LSA. Some wetland site series are correlated with ECARs (see above).

Table 6-3 Wetlands Mapped Within the LSA

Biogeoclimatic subzone variant	Wetland Name	TEM Code	Total (ha)
BGxw1	Alkaline Pond	AK	3.7
	Open water	OW	5.3
	Pond	PD	10.2
	Alkali Saltgrass herbaceous meadow	Gs01	5.6
	Beaked sedge -Water sedge	Wm01	0.9
	Cattail marsh	Wm05	8.0
BGxw1 Total			33.7
IDFxh2	Alkaline Pond	AK	7.7
	Lake	LA	73.0
	Open water	OW	15.1
	Pond	PD	13.8
	Alkali Saltgrass herbaceous meadow	Gs01	2.6
	Nuttall's alkaligrass-Foxtail barley	Gs02	9.9
	Beaked sedge -Water sedge	Wm01	7.4
	Cattail marsh	Wm05	12.2

Biogeoclimatic subzone variant	Wetland Name	TEM Code	Total (ha)
	Great bulrush marsh	Wm06	10.9
	Baltic rush saline marsh	Wm07	7.7
	Bebb's willow-Bluejoint	Ws03	16.0
	Drummond's willow-Beaked sedge	Ws04	2.5
IDFxh2 Total			178.7
PPxh2	Alkaline Pond	AK	5.2
	Alkali Saltgrass herbaceous meadow	Gs01	3.1
PPxh2 Total			8.3
Grand Total			220.6

Riparian Habitat

Riparian habitat mapped within the LSA within the TEM totalled approximately 31.1 ha and included riparian shrub land (52) and Aspen units (10) with an active floodplain modifier (**Table 6-4**).

Table 6-4 Riparian Units Mapped Within the LSA

Biogeoclimatic subzone variant	Wetland Name	TEM Code	Total (ha)
IDFxh2	Water birch – Northern bedstraw	52	9.1
	Aspen – Snowberry - Rose	10	22.0
IDFxh2 Total			31.1
Grand Total			31.1

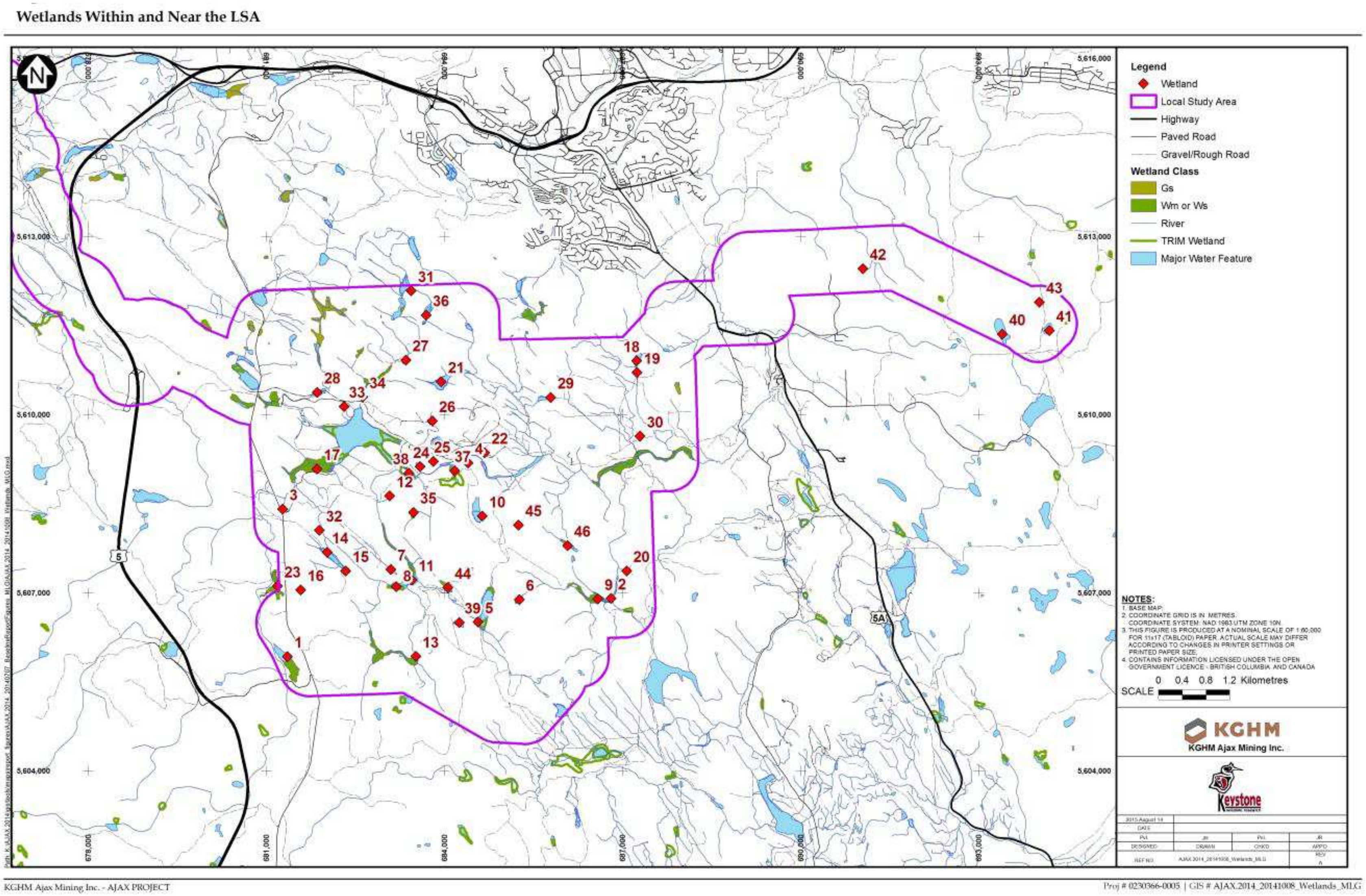


Figure 6-1 Wetlands Within and Near the LSA

The wetlands within the LSA are mainly small depressional wetlands with riverine-types along Peterson and Jocko Creeks and lake fringes along the shores of Jacko Lake. Wetlands in the LSA have a variety of functions in relation to terrestrial wildlife, plants and ecosystems as summarized in **Table 6-5**.

Table 6-5 Functions of Wetlands in the LSA as Pertaining to Terrestrial Wildlife and Vegetation

Broad Function Category	Specific Function
Habitat	Drinking water for wildlife
	Breeding habitat for Great Basin spadefoot, western toad, Columbia spotted frog
	Breeding and foraging habitat for waterfowl, Great Blue Heron, American Bittern, Sandhill Crane, Short-eared Owl
	Migration habitat for waterfowl and water-associated birds
	Foraging habitat for snakes
	Foraging habitat for bats
	Foraging habitat for deer and moose
	Breeding habitat for dragonflies and damselflies
	Habitat for rare plants and Ecological Communities at Risk
Hydrologic	Reduction of flow velocity (flood control and shoreline stabilization)
	Recharge and discharge of groundwater
Water Quality	Filtering of pollutants
	Sediment trapping
	Nutrient retention
	Biogeochemical cycling

Many of the small depressional wetlands in the LSA had minimal vegetation around the edges, likely due to frequent disturbance from cattle (**Plate 6-1**). The sparse vegetation cover limits their usefulness as habitat for many species although they would still be valuable sources of drinking water for many wildlife species and provide breeding habitat for western toads and Great Basin spadefoot.

Temporary waterbodies formed during spring and early summer on the grasslands tended to dry out by midsummer (**Plate 6-2**). Some of the temporary waterbodies only became wetted every few years when there was a particularly wet spring.

Plate 6-1 Cattle Trampling Impacts to Wetland

Plate 6-2 Temporary Wetland

The alkaline wetlands in the LSA are used by migratory birds such as Sandhill Cranes as stopover sites during migration. The salinity of these small waterbodies means that they thaw earlier than non-saline water features. Early waterfowl use of Wallender Lake was noted while Jacko and Inks lakes were still frozen (see Section 11.3). However, their poor water quality makes them unattractive to most wildlife when alternate habitats are available.

Wetlands with emergent or shoreline vegetation are used by waterfowl and passerine birds for nesting. Beavers (*Castor canadensis*) may use wetlands that are relatively large and have a good supply of nearby deciduous trees for feeding. Muskrats (*Ondontra zibethica*) don't require trees but do need aquatic plants to feed on. Dragonflies and damselflies are found at most wetlands in the LSA but more species are present at sites with a diversity of vegetation types. Section 5.3 includes a discussion of wetlands as rare plant habitat.

The largest well-vegetated wetlands in the LSA are found in the southwest arm of Jacko Lake (the Jacko Creek inlet to the lake), the northeast arm of Jacko Lake, along Peterson Creek, and a marsh complex about 2 km south of Jacko Lake and 1200 m west of Goose Lake.

Rock Outcrops

Rock outcrops (**Plate 6-3)** were usually mapped as polygon components rather than pure polygons. Areas of rock ecosystems mapped are summarized in **Table 6-6**. Rock outcrops in the LSA are sparsely vegetated with bluebunch wheatgrass, Wallace's selaginella (*Selaginella wallacei*), *Peltigera* lichens, and Cladonia lichens. Occasional ponderosa pines or Douglas-firs may take root in crevices, along with choke cherry (*Prunus virginiana*) and saskatoon (*Amelanchier alnifolia*). Section 5.3 includes a discussion of rock outcrops as rare plant habitat.

Plate 6-3 Rock Outcrop east of Goose Lake Road

Table 6-6 Area of Rock Outcrops Mapped in the LSA

Biogeoclimatic Subzone Variant	Name	Site Series	**Total** in LSA (ha)
IDFxh2	Selaginella -Clad lichens	73	64.1
PPxh2	Bluebunch wheatgrass - Selaginella	Ro02	0.9
Grand Total			**65.0**

<u>Old-growth Forest</u>

Structural stage 7 (old-growth) was rarely mapped in the LSA due to its history of timber harvest and fire. Only 19.8 ha was mapped in the LSA, all in the IDFxh2. Large old veteran trees may be present in forests and grasslands but these isolated trees would not be identified by the mapping. Many large old ponderosa pines on the LSA have been recently killed by pine beetle and are not expected to remain standing for long. Section 5.3 includes a discussion of forests as rare plant habitat.

Portions of Old Growth Management Areas are present in the LSA; TKA725 on the southern border of the LSA (38 ha overlap), TKA703 in the southwest corner of the LSA (5 ha overlap), and a very small fragment (0.07 ha overlap) of TKA694 on the southern border of the LSA (**Figure 3-1**).

7.0 GRASSLANDS

7.1 Baseline

Grasslands (**Plate 7-1**) typically include areas dominated by graminoid vegetation where tree cover is less than 10%. Grasslands in BC are one of Canada's most endangered ecosystems (BC Ministry of Water, Land and Air Protection and Grasslands Conservation Council of BC 2004) and are vulnerable to loss or degradation as a result of Project activities. In BC, grasslands are rare (< 1% of provincial land base) ecosystems that are able to support a diversity of plant and animal life. They provide habitat for many wildlife species (including a number that are considered at-risk), grazing opportunities for livestock and sites for recreational activities (*ibid*.).

Plate 7-1 Balsamroot and Lupine Blooming in Grassland (L. Andrusiak photo)

Kamloops has been identified as a critical junction between several major grassland regions within the province, with several unique features in the Aberdeen area, such as alkaline ponds, talus slopes, and badger habitat (City of Kamloops n.d.). The majority of the grassland in the LSA is classified as Upper Grassland (Wikeem & Wikeem 2004). Grasslands in good condition are dominated by bunchgrasses, especially bluebunch wheatgrass and rough fescue. Common forbs include arrow-leaved balsamroot (*Balsamorhiza sagittata*), prairie sagewort (*Artemisia frigida*), parsnip-flowered buckwheat (*Eriogonum heracleoides*), silky lupine (*Lupinus sericeus*), milk-vetches (*Astragalus* spp.), yarrow (*Artemisia millefolium*), desert-parsleys (*Lomatium* spp.), and lemonweed (*Lithospermum ruderale*). A cryptogamic crust of mosses, algae, lichens and bacteria is present on the soil surface (Hope et al. 1993). Shrub-steppe grasslands have a higher cover of big sage and other shrubs such as common rabbitbrush.

Grasslands are sensitive to the effects of human developments. Edge effects of development on grasslands include increased presence of weedy exotic species, damage to the delicate cryptogamic crust, and changes in soil characteristics (Gieselman et al. 2013). Overgrazing causes a shift from bunchgrass species to less palatable (and often weedy) grasses and forbs (Hope et al. 1993).

Grasslands were mapped throughout the LSA in the TEM. Anthropogenic map units (the map units Mine, Mine Tailings and Cultivated Field) are not considered in the 'grasslands' category, but shrub-steppe ecosystems are included as grasslands (see Section 5.3 for additional information on grasslands as rare plant habitats). Grassland ecosystems listed by the BC CDC as ECARs are presented in **Table 7-1** below. None are listed as Identified Wildlife. Some of the ECARs are potentially present in all three subzone variants in the TEM while others are present in only one.

Table 7-1 Grassland Ecological Communities at Risk and Their Correlation with Site Series

Scientific Name	English Name	BC List*	Conservation Framework Highest Priority	Associated Site Series		
				BGxw1	PPxh2	IDFxh2
Artemisia tridentata / Pseudoroegneria spicata	big sagebrush / bluebunch wheatgrass	Red	1	81ls	83ls	n/a
Festuca campestris - Pseudoroegneria spicata	rough fescue - bluebunch wheatgrass	Red	2	83ls/83	n/a	83
Pseudoroegneria spicata - Koeleria macrantha	bluebunch wheatgrass - junegrass	Blue	2	81	n/a	82
Leymus cinereus Herbaceous Vegetation	giant wildrye Herbaceous Vegetation	Red	3	84	n/a	n/a

7.2 Methods

Ecosystem Mapping Summaries

Quantification of grassland ecological communities and grassland habitats was completed by theming the ecosystem map to identify polygons where any grasslands were mapped in any decile.

Grasslands Mapping

The objective of the BC Grasslands Mapping Project (Grasslands Conservation Council (GCC) of BC 2004) was to '*provide information and a clear provincial picture on the abundance, distribution and status of BC's grasslands*.' The result of the Project was a GIS layer identifying native grassland throughout the province. The spatial files of the Grasslands Mapping Project were obtained from the BC MOE and overlain on the LSA and RSA to summarize the amount of grassland habitat within each area.

Much of the LSA has been included in priority grasslands conservation areas delineated by the Grasslands Conservation Council of BC (2009). Spatial boundaries of the proposed priority grasslands areas were obtained and used to quantify the amount of priority grasslands within the LSA and RSA boundaries.

Grasslands Condition Assessment

An evaluation of grassland condition was carried out, concentrated on Project footprint areas. Grasslands evaluation methodology followed that described in Delesalle et al. (2009), which involves assessment of a variety of ecological attributes including bunchgrass cover, cover of shrubs, tall forbs, medium forbs, low forbs and soil crust, and presence of erosion features and invasive species to determine a final score out of a maximum of 100. Scores higher than 75 indicate grasslands in reference condition, scores of 51-75 indicate grasslands that are "Slightly Altered", "Moderately Altered" is indicated by 26-50, and "Greatly Altered" by 0-25. Soil compaction was also assessed at some sites using a hand-held penetrometer.

7.3 Results

Ecosystem Mapping Summaries

Grasslands in general are considered sensitive ecosystems in BC, and the site series guide used for the TEM map is a draft and will be revised in the future (M. Ryan, pers. comm.). Therefore, for the purposes of the assessment, all native grassland site series are treated as sensitive ecosystems under the broad category of 'grasslands'. Approximately 3,322 ha of grasslands (**Table 7-2**) were mapped within the LSA**.** Totals do not include areas mapped as Cultivated Field or Reclaimed Mine.

Table 7-2 Grasslands TEM-Mapped Within the LSA

Biogeoclimatic Subzone Variant	Name	Site Series	Total Mapped (ha)
BGxw1	Bluebunch wheatgrass - Sandberg's bluegrass	81	371.5
	Rabbitbrush-Bluebunch wheatgrass-Selaginella	82	1.6
	Rough fescue	83	40.4
	Giant wildrye - Kentucky bluegrass	84	12.7
BGxw1 Total			426.2
IDFxh2	Rough fescue	81	445.3
	Bluebunch wheatgrass - Sandberg's bluegrass	82	845.0
	Rough fescue -Bluebunch wheatgrass	83	1494.5
IDFxh2 Total			2784.7
PPxh2	Bluebunch wheatgrass - Sandberg's bluegrass	82	63.9
	Rough fescue -Bluebunch wheatgrass	83	42.3
	Rough fescue	84	5.2
PPxh2 Total			111.5
Grand Total			3322.4

Seven site series correlated with the four grassland ECARs were mapped in the LSA. Four were mapped in the BGxw1, two in the IDFxh2 and one in the PPxh2 (**Table 7-3**). Some site series (BGxw1 – 81) are correlated with more than one ECAR, so totals are not additive.

Table 7-3 At-risk Grassland Ecosystems Correlated With TEM-Mapped Site Series Mapped in the LSA

BEC Variant	Ecological Community at Risk	Site Series	Provincial List	Associated Site Series Name	Total Mapped (ha)
BGxw1	Bluebunch wheatgrass-Junegrass	81	Blue	Bluebunch wheatgrass - Sandberg's bluegrass	371.5
	Big sagebrush /bluebunch wheatgrass		Red	Bluebunch wheatgrass-Sandberg's bluegrass	
BGxw1	Rough fescue - bluebunch wheatgrass	83	Red	Rough fescue	40.4
BGxw1	Giant Wildrye herbaceous vegetation	84	Red	Giant wildrye - Kentucky bluegrass	12.7
IDFxh2	Bluebunch wheatgrass-Junegrass	82	Blue	Bluebunch wheatgrass - Sandberg's bluegrass	845.0
IDFxh2	Rough fescue - Bluebunch wheatgrass	83	Red	Rough fescue - Bluebunch wheatgrass	1494.5
PPxh2	Big sage-Bluebunch wheatgrass	83	Red	Rough fescue - Bluebunch wheatgrass	42.3

Priority Grasslands Mapping

The RSA and LSA boundaries were overlain with the grasslands map coverage produced by the BC Grasslands Mapping Initiative (Grasslands Conservation Council (GCC) of BC 2004). There were 38,405 ha of open grassland habitat mapped in the RSA and 4,427 ha within the LSA (**Table 7-4)**.

In total, the Priority Grasslands Mapping mapped 23,006 ha of terrestrial priority grasslands within the Thompson Basin (THB) portion of the RSA, of which 2,528 ha were mapped within the LSA. The mapping initiative also identified both riparian priority areas and working landscape areas within the LSA (**Table 7-4; Figure 7-1).** Portions of nine Terrestrial Priority Grassland Areas are present within the LSA (**Table 7-5**). Regional targets for grassland mapping were 40% of the landbase of current existing grasslands. Areas excluded from mapping were located within a 100-m buffer around main roads, and in future development zones as identified in KAMPLAN (2004).

Table 7-4 Summary of Priority Grasslands Identified by the Grasslands Mapping Initiative in Relation to the Project

Classification	Ha in LSA	Ha in RSA	Ha in THB
Open Grassland	4,427.0	38,404.8	94,766.3
Terrestrial priority areas	2,528.2	23,006.7	110,150.8
Riparian priority areas	300.3*	3,249.0*	9210.8*
Working landscape	4,202.2	35,604.3	112,040.0

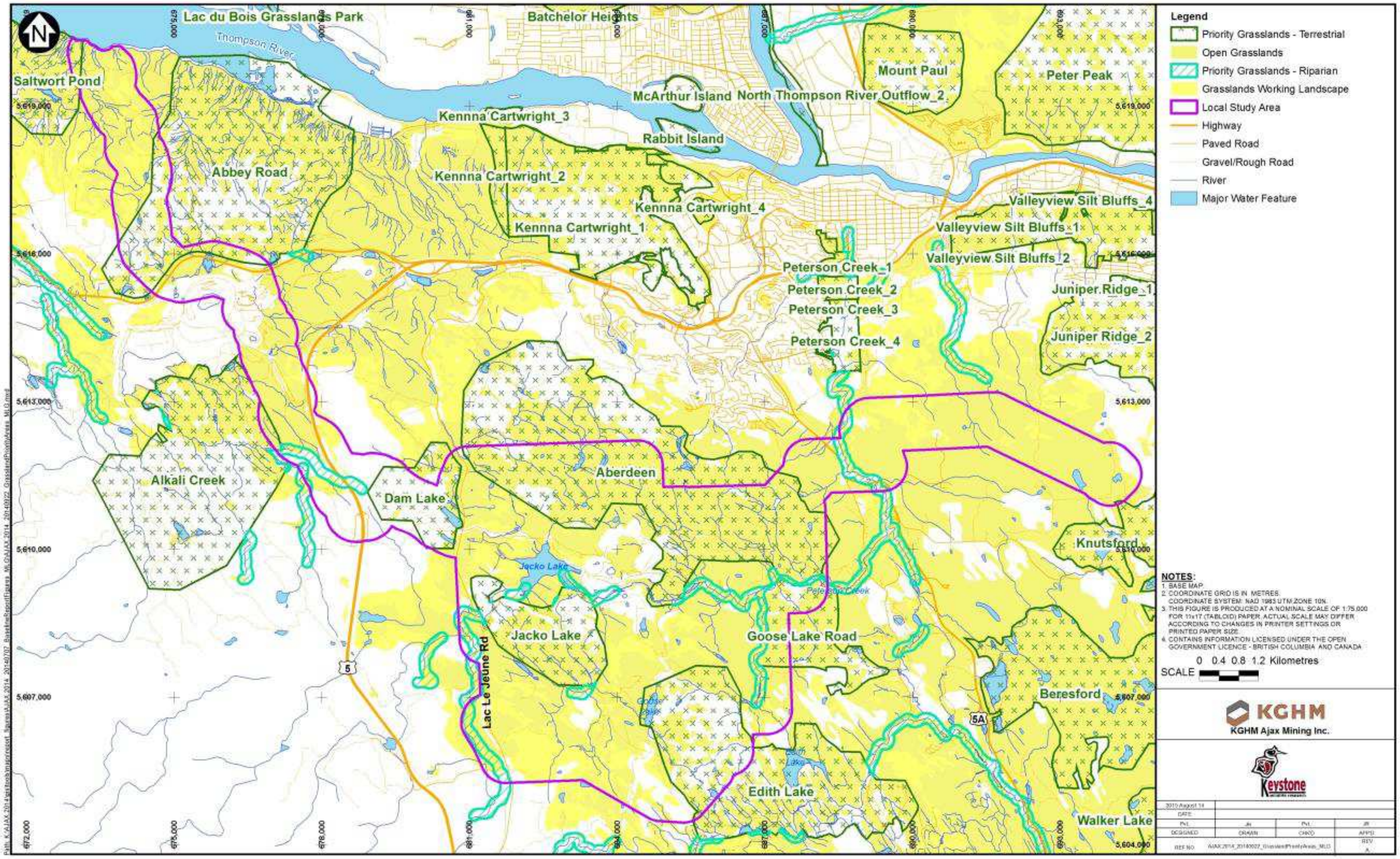
*note that classifications overlap so areas are not additive

Table 7-5 List of Terrestrial Priority Grassland Areas Within the LSA

Name	Ha in LSA
Saltwort Pond	19.8
Abbey Road	229.8
Alkali Creek	19.3
Aberdeen	1,103.9
Dam Lake	215.9
Goose Lake Road	126.1
Edith Lake	450.8
Knutsford	0.7
Jacko Lake	361.8
Total	**2,528.2**

Roughly 94% of the LSA had a grasslands classification. The regional context indicates that the LSA has a lower proportion of priority grasslands as only 37% of area is delineated as priority grasslands compared to 39% in the RSA and 49% for the Thompson Basin ecosection. The target set for Priority Grasslands was that it would contain roughly 40% of the land base of current existing grasslands.

Grassland Mapping and Priority Areas



KGHM Ajax Mining Inc. - AJAX PROJECT

Proj # 0230366-0005 | GIS # AJAX 2014_20140922_GrasslandPriorityAreas_MLG

Figure 7-1 Grasslands Priority Areas

Grasslands Condition Assessment

Grasslands condition assessment field surveys took place July 15 to 18, 2010; June 4, 2011; and August 9 to 13, 2014. In total, 109 plots and spot assessments were recorded in the LSA and immediate vicinity (**Figure 7-2**).

The highest average scores for grassland condition within Project development areas were found in the plant site area. Six plots were completed there, with an average score of 74 (Slightly Altered) and a range of 51 to 94 (**Table 7-6**). The nearby ore stockpile area also averaged a Slightly Altered rating (final score average of 63); although only two plots were read at that location.

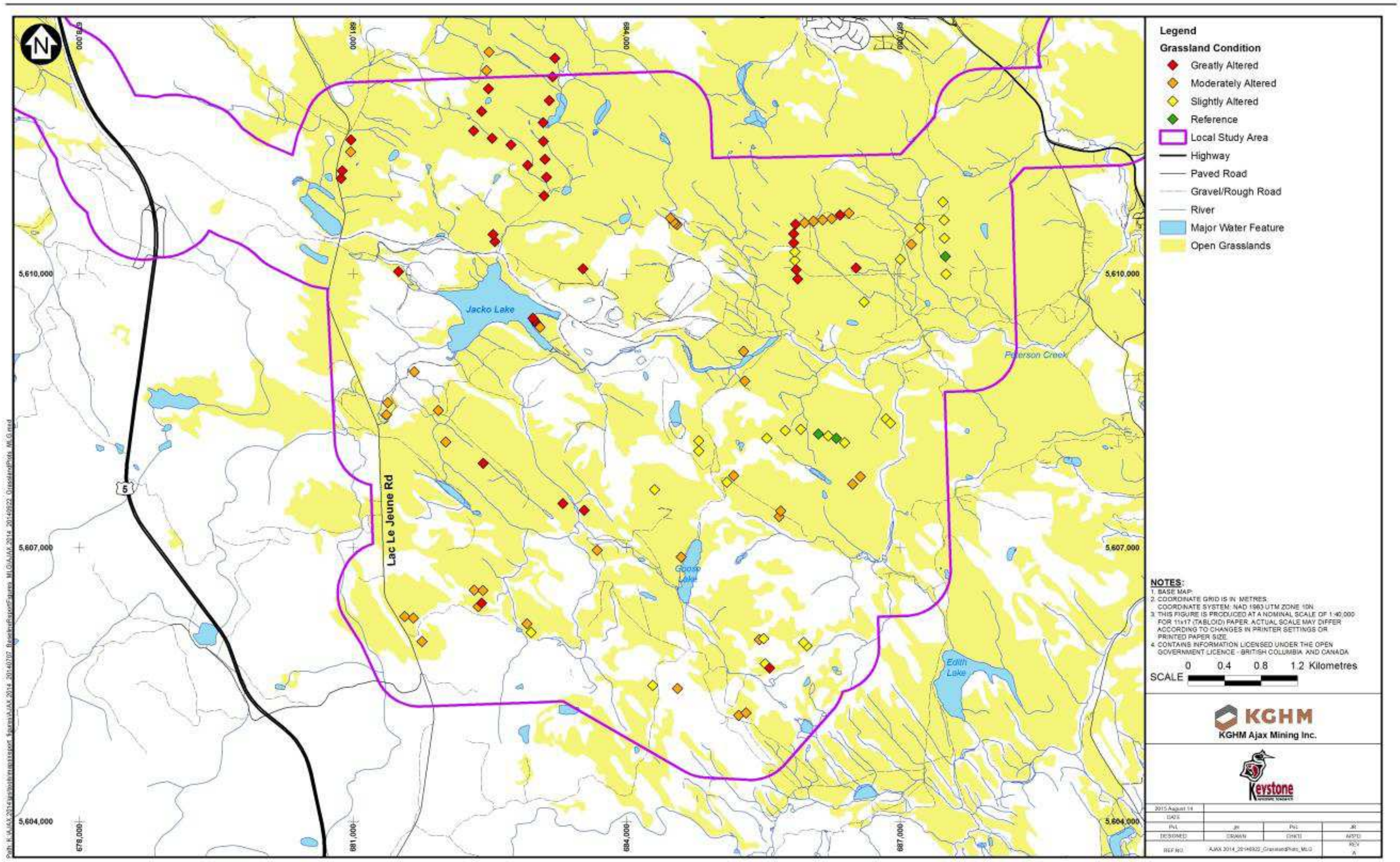
Table 7-6 Summary of Grassland Condition Scores by Facility

Facility	n	Average Score	Standard Deviation of Mean	Minimum Score	Maximum Score
Plant	6	74	13	51	94
Ore Stockpile	2	63	0	63	63
South MRSF	9	48	12	28	66
East MRSF	17	44	22	18	88
TSF	21	38	16	5	73
Pit	9	32	14	9	46
No Facility	45	28	22	2	90
TOTAL	109	38	22	2	94

The remaining facilities all averaged within the Moderately Altered category. The South Mine Rock Storage Facility (South MRSF) averaged a rating of 48, which was slightly higher than the East Mine Rock Storage Facility (East MRSF) at 44. The proposed pit footprint had the lowest average rating at 31.

For the LSA as a whole–across all 109 grassland condition plots–the average final score was 38 (Moderately Altered). In general, as can be seen in **Figure 7-2**, the grasslands were found to be in better condition toward the southeast portions of the LSA. The average grassland condition score for the 39 plots lying to the southeast of a diagonal line drawn through the middle of the disturbance area is 56 (Slightly Altered), while the average for the plots on the northwest side of that line is 27 (Moderately Altered). These slightly altered grassland conditions are likely a result of the historical mining activity on site.

Locations of Grassland Condition Plots



Proj # 0230366-0005 | GIS # AJAX2014_20140922_GrasslandPlots_MLG

Figure 7-2 Locations of Grassland Condition Plots

8.0 TERRESTRIAL INVERTEBRATES

8.1 Baseline

Four butterfly species and one dragonfly species are used as indicators for the terrestrial invertebrate VC. Their biology and life histories are described briefly below.

Monarch

The monarch is a Blue-listed butterfly species that in BC is strongly associated with its larval host plant, showy milkweed (*Asclepias speciosa*). The monarch is also listed on SARA's Schedule 1 as a species of Special Concern (BC Conservation Data Centre 2014a).. It flies in June to late July, and may potentially be found in many low-elevation habitats as a migrant. Migration begins in late summer and fall, when the butterflies move southwards to overwintering sites in California or Mexico (Klinkenberg 2012a). Showy milkweed was recorded during field surveys of the LSA, so the monarch may be present.

Nevada Skipper

The orange Nevada skipper is a Blue-listed butterfly that inhabits grasslands. There are location records for this species from Tranquille (BC Conservation Data Centre 2014a). Its larval food plants are probably sheep fescue (*Festuca ovina*) and western needlegrass (*Stipa occidentalis*) (Layberry et al. 1998). This species flies from mid-May to mid-June and is associated with dry to xeric ridgetops (Klinkenberg 2014).

Common Sootywing

The common sootywing is a dark butterfly known from the Kamloops area (BC Conservation Data Centre 2014a). Its larval food plant is lamb's-quarters (*Chenopodium album*) and as a result it is often found in weedy areas where this plant is abundant. Its flight period is late May to mid-June, and from mid-July to late August (Klinkenberg 2012b). Threats to the common sootywing are thought to include development of xeric valley bottom habitats, and habitat alteration due to overgrazing, invasive weeds and off-road vehicle use (BC Conservation Data Centre 2014a).

California Hairstreak

The California hairstreak is Blue-listed (BC Conservation Data Centre 2014a). The larvae of this butterfly feed on *Ceanothus* shrubs as well as cherry (*Prunus* sp.) and saskatoon (*Amelanchier* sp.) (Layberry et al. 1998). The species has been recorded from the South Thompson River east of Kamloops (BC Conservation Data Centre 2014a) although more commonly in the Okanagan and Lillooet (Layberry et al. 1998). It flies in dry, open habitats from June through August (Jones 1951 in Layberry et al. 1998).

Olive Clubtail

The olive clubtail is a grey-green dragonfly that inhabits sandy or muddy streams and lakeshores, and has been found along the South Thompson River near Kamloops (COSEWIC 2011a). It is provincially Red-listed and COSEWIC-listed as Endangered (BC Conservation Data Centre 2014a).

The aquatic larvae live in the bottom sediments and emerge as adults after about two years. In BC it flies from mid-July until October (COSEWIC 2011a). Males patrol over water and both sexes rest on shoreline shrubs. The distribution of the olive clubtail in the province is restricted and few occurrences are known. The main threats to this species are thought to be habitat loss (including shoreline development, channelization and loss of riparian vegetation) and introduced predatory fish that consume aquatic larvae (COSEWIC 2011a).

8.2 Methods

Surveys for invertebrates (primarily butterflies and dragonflies) were carried out using methods consistent with provincial Resources Information Standards Committee (RISC) standards. Dragonflies, damselflies and butterflies were surveyed using hand-netting techniques (Resources Inventory Committee 1998) by a two-person crew consisting of two biologists, one of whom was an expert in dragonfly and butterfly identification. Both vehicle and foot transects were used, concentrating on Project footprint areas. Surveys took place in suitable weather (no rain or high winds), beginning about 09h30 in the morning and continuing until late in the afternoon, about 17h00. Butterflies and dragonflies were detected visually and captured in hand nets. Captured individuals were identified in the hand by the expert and then released. Dragonflies are particularly difficult to net, so the majority of dragonfly species were identified visually through binoculars.

8.3 Results

Invertebrate surveys were carried out from June 19 to 23, 2010, June 25 to 26, 2011, July 25 to 28, 2011, June 19 to 21, 2014, and August 8 to 10, 2014. Survey transects and points are presented in **Figure 8-1.** A summary of invertebrate survey effort is presented in **Table 8-1**.

Table 8-1 Summary of Invertebrate Survey Effort

Year	Number of Locations Surveyed (including repeat surveys)	Total Time Surveyed (person-hours)
2010	11	39h58
2011	20	57h12
2014	32	45h38
Grand Total	63	142h48

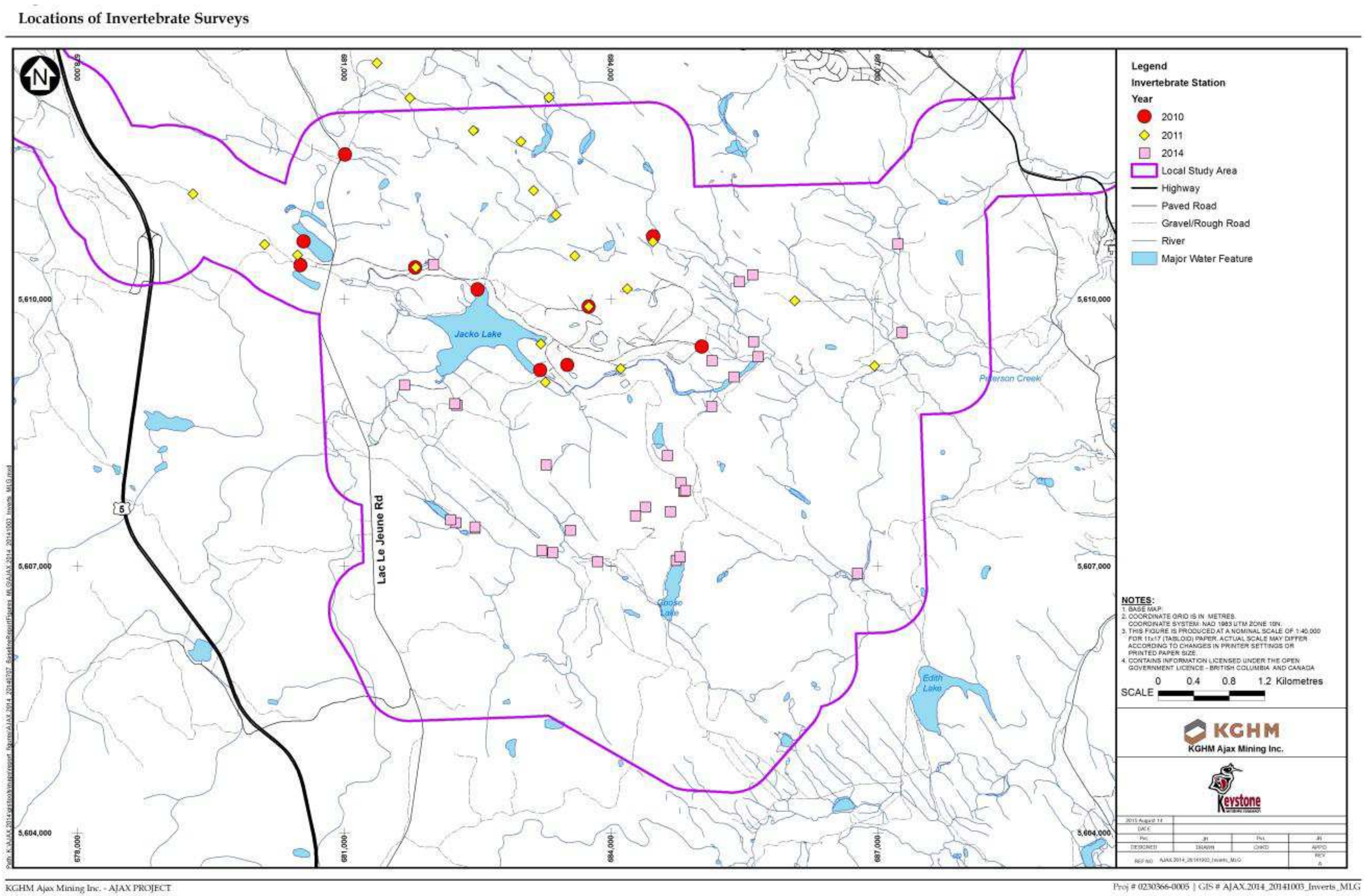


Figure 8-1 Locations of Invertebrate Surveys

Seventy-seven invertebrate taxa were identified, including 21 dragonfly/damselfly taxa (**Plate 8-1**) and 56 butterflies (**Table 8-2**). No listed species were observed.

Plate 8-1 Pair of Captured Darners (L. Andrusiak photo)

Table 8-2 Butterfly and Dragonfly/damselfly Taxa Identified During Field Surveys in 2010, 2011 and 2014

English Name	Scientific Name	Provincial Status	Total Identified
	Butterflies		
Acmon Blue	*Plebejus lupini*	Yellow	27
Anicia Checkerspot	*Euphydryas anicia*	Yellow	26
Anise Swallowtail	*Papilio zelicaon*	Yellow	2
Arrowhead Blue	*Glaucopsyche piasus*	Yellow	5
Becker's White	*Pontia beckerii*	Yellow	22
Blue Copper	*Lycaena heteronea*	Yellow	7
Boisduval's Blue	*Plebejus icarioides*	Yellow	135
Cabbage White	*Pieris rapae*	Exotic	40
Callippe Fritillary	*Speyeria callippe*	Yellow	2
Canada Tiger Swallowtail	*Papilio canadensis*	Yellow	6
Checkered White	*Pontia protodice*	Accidental	1
Chryxus Arctic	*Oeneis chryxus*	Yellow	3

English Name	Scientific Name	Provincial Status	Total Identified
Clouded Sulphur	*Colias philodice*	Yellow	48
Common Alpine	*Erebia epipsodea*	Yellow	43
Common Branded Skipper	*Hesperia comma*	Yellow	18
Common Ringlet	*Coenonympha tullia*	Yellow	179
Common Woodnymph	*Cercyonis pegala*	Yellow	8
European Skipper	*Thymelicus lineola*	Exotic	36
Field Crescent	*Phyciodes pulchella*	Yellow	15
Great Spangled Fritillary	*Speyeria cybele*	Yellow	10
Greenish Blue	*Plebejus saepiolus*	Yellow	6
Inicia Checkerspot	*Euphydryas anicia*	Yellow	22
Juba Skipper	*Hesperia juba*	Yellow	2
Large Marble	*Euchloe ausonides*	Yellow	42
Meadow Fritillary	*Boloria bellona*	Yellow	1
Melissa Blue	*Plebejus melissa*	Yellow	9
Milbert's Tortoiseshell	*Aglais milberti*	Yellow	3
Mormon Fritillary	*Speyeria mormonia*	Yellow	1
Mourning Cloak	*Nymphalis antiopa*	Yellow	3
Mylitta Crescent	*Phyciodes mylitta*	Yellow	1
Northwestern Fritillary	*Speyeria hesperis*	Yellow	1
Northern Blue	*Plebejus idas*	Yellow	54
Northern Checkerspot	*Chlosyne palla*	Yellow	2
Northern Crescent	*Phyciodes cocyta*	Yellow	6
Northern Crescent, *pascoensis* subspecies	*Phyciodes cocyta pascoensis*	Yellow	1
Northwestern Fritillary	*Speyeria hesperis*	Yellow	10
Old World Swallowtail	*Papilio machaon oregonius*	Yellow	10
Orange Sulphur	*Colias eurytheme*	Yellow	15
Pale Crescent	*Phyciodes pallida*	Yellow	3
Pearl Crescent	*Phyciodes cocyta*	Yellow	31
Persius Duskywing	*Erynnis persius*	Yellow	1
Pink-edged Sulphur	*Colias interior*	Yellow	3
Purplish Copper	*Lycaena helloides*	Yellow	35
Rocky Mountain Parnassian	*Parnassius smintheus*	Yellow	8
Silver-bordered Fritillary	*Boloria selene*	Yellow	2
Silvery Blue	*Lycaena helloides*	Yellow	23
Small Woodnymph	*Cercyonis oetus*	Yellow	84
Square-spotted Blue	*Euphilotes battoides*	Yellow	8
Stella Orangetip	*Anthocharis stella*	Yellow	1
Two-tailed Swallowtail	*Papilio multicaudata*	Yellow	1
Western Sulphur	*Colias occidentalis*	Yellow	5
Western Swallowtail	*Papilio rutulus*	Yellow	2
Western Tailed Blue	*Cupido amyntula*	Yellow	4

English Name	Scientific Name	Provincial Status	Total Identified
Western Tiger Swallowtail	*Papilio rutulus*	Yellow	1
Western White	*Pontia occidentalis*	Yellow	27
Zerene Frittilary	*Speyeria zerene*	Yellow	1
Sulphur sp.			7
Tiger Swallowtail sp	*Papilio* sp.		3
Unknown Fritillary			2
White Sp.			2
Fritillary Sp			2
Total			1078
Dragonflies and Damselflies			
Black Meadowhawk	*Sympetrum danae*	Yellow	6
California Darner	*Rhionaeschna californica*	Yellow	5
Cherry-faced Meadowhawk	*Sympetrum internum*	Yellow	72
Northern spreadwing	*Lestes disjunctus*	Yellow	17
Emerald Spreadwing	*Lestes dryas*	Yellow	3
Four-spotted Skimmer	*Libellula quadrimaculata*	Yellow	3
Hudsonian Whiteface	*Leucorrhinia hudsonica*	Yellow	1
Lyre-tipped Spreadwing	*Lestes unguiculatus*	Yellow	180
Northern Bluet	*Enallagma annexum*	Yellow	210
Pacific Forktail	*Ischnura cervula*	Yellow	6
Paddle-tailed Darner	*Aeshna palmata*	Yellow	12
Red-veined Meadowhawk	*Sympetrum madidum*	Yellow	12
Saffron-winged Meadowhawk	*Sympetrum costiferum*	Yellow	11
Spotted Spreadwing	*Lestes congener*	Yellow	5
Striped Meadowhawk	*Sympetrum pallipes*	Yellow	9
Taiga Bluet	*Coenagrion resolutum*	Yellow	1
Tule Bluet	*Enallagma carunculatum*	Yellow	1
Variable Darner	*Aeshna interrupta*	Yellow	6
Variegated Meadowhawk	*Sympetrum corruptum*	Yellow	3
Western Forktail	*Ischnura perparva*	Yellow	3
White-faced Meadowhawk	*Sympetrum obtrusum*	Yellow	7
Total			573

Notable incidental invertebrate detections include the western bumblebee (*Bombus occidentalis*) foraging on white sweet-clover (*Melilotus alba*) on the existing waste rock dump near the Ajax pits. Western bumblebee populations have declined sharply and a COSEWIC status report for the species is in preparation (COSEWIC 2013a). Both subspecies of western bumblebee were listed as 'Special Concern' by COSEWIC in May 2014 but the western bumblebee is not currently listed provincially.

9.0 REPTILES

9.1 Baseline

Four species are used as indicators for the reptile VC. Brief descriptions of the biology of the four taxa are provided below.

Northern Rubber Boa

The rubber boa is a small boa that feeds primarily on small mammals. It is Yellow-listed provincially, and Federally listed on SARA's Schedule 1 as a species of Special Concern (BC Conservation Data Centre 2014a). Rubber boas are mainly found in the southern third of the province, from the Thompson River basin south (Cameron & St. Clair 2003). Rubber boas use most habitat types, but require cover in the form of abundant CWD, mammal burrows or rock crevices (Cameron & St. Clair 2003). They are most common in rocky outcrops in forest clearings, where they use the rock for thermoregulation. Rubber boas forage at night and spend days under cover. Females may only reproduce every four years, when they give birth to live young in mid-summer (Cameron & St. Clair 2003). The rubber boa was detected during field surveys on Sugarloaf Hill in 2008, and has also been observed at the Abacus Camp (R. Falls, pers. comm.).

Great Basin Gophersnake

The Great Basin gophersnake is provincially Blue-listed, listed as Threatened on SARA's Schedule 1, and is an Identified Wildlife species (BC Conservation Data Centre 2014a). Gophersnakes have a limited distribution in low-elevation grassland, shrub-steppe and dry forest habitats (BC Ministry of Water, Land and Air Protection 2004).

Gophersnakes feed primarily on small mammals and juvenile birds, which they kill by constriction. Breeding occurs during the summer, when several females may lay their eggs in the same patch of well-drained soil or talus, or within abandoned rodent burrows. Gophersnakes often hibernate in communal dens, often within fissures at the base of rock cliffs or crevices in talus slopes (BC Ministry of Water, Land and Air Protection 2004), but may also hibernate individually in rodent burrows. Habitat loss due to urbanization and agriculture, and direct mortality from roadkills and human persecution, are thought to threaten gophersnake populations (COSEWIC 2013b).

Gophersnakes were not detected during wildlife surveys and hibernaculum surveys around Project footprint areas in 2007, 2008, 2010 or 2014. Local residents have reported the presence of 'bull snakes' in the area historically, and Abacus staff reported finding a small gophersnake near the Ajax pits in the summer of 2009 and another in 2014. It is possible that small populations of this species exist in the LSA, and growing season habitat in the LSA is suitable for the species. Snakes are particularly vulnerable to roadkill mortality and to disturbance of rocky areas. A species account for gophersnake is presented in **Appendix 9.**

North American Racer

The North American racer is a slender snake that uses open habitats and preys on a variety of small mammals, birds, reptiles, amphibians and insects. The species is provincially Blue-listed and is an Identified Wildlife species (BC Conservation Data Centre 2014a). The BC subspecies *C. c. mormon* (western yellow-bellied racer) is listed on SARA's Schedule 1 as a Special Concern. Racers are found in the dry grasslands of the middle Fraser, Nicola, Okanagan and Thompson drainages (Cannings et al. 1999). Racers forage in low-elevation grassland habitats during the warm months of the year, and hibernate in communal hibernacula in rock crevices during the winter (Cannings et al. 1999). Hibernacula are located on warm slopes in grasslands or in open forests (BC Ministry of Water, Land and Air Protection 2004). The snakes re-emerge in April or May, and after breeding, the females lay eggs in communal nests in talus or abandoned mammal burrows on warm slopes (Cannings et al. 1999). Racers generally move only about 1 km to 2 km from their hibernaculum (BC Ministry of Water, Land and Air Protection 2004). Talus slopes, rock outcrops, coarse woody debris and vegetative cover are considered critical habitat elements (BC Ministry of Water, Land and Air Protection 2004).

Habitat loss due to urbanization and agriculture, combined with roadkills, human persecution and disturbance of hibernacula, is thought to pose the greatest threat to the species (BC Ministry of Water, Land and Air Protection 2004). No records of racers in the immediate area could be located, and the species was not detected during field surveys in 2007, 2008, 2010 or 2014. Suitable habitat is present throughout the LSA, and small racer populations may be present. A species account for the racer is presented in **Appendix 9**.

Western Rattlesnake

The western rattlesnake is a thick-bodied, venomous snake that is provincially Blue-listed and is listed as Threatened under Schedule 1 of SARA (BC Conservation Data Centre 2014a). The rattlesnake is restricted to the very dry BC interior. Rattlesnakes usually emerge from hibernacula in March to May, depending on weather. Gravid females remain near the den and give birth between August and October. Rattlesnakes are most often found on warm, rocky slopes. Deer mice, pocket gophers, chipmunks, young marmots, birds and squirrels form the majority of the diet (Didiuk et al. 2004). Rattlesnakes return to hibernacula by October. Hibernacula are generally on southeast through southwest facing slopes, usually where deep fissures are present in exposed bedrock or colluvium, and are traditionally used (Sarell 1993). Rattlesnakes are threatened by roadkills, destruction of hibernacula, and persecution by people. A revised COSEWIC status report is in preparation (Andrusiak & Sarell in prep.).

Suitable habitat is present in the LSA for rattlesnakes, although no records of rattlesnakes could be located. Rattlesnakes were not observed during 2007, 2008 or 2010 wildlife surveys, nor were they detected by Rescan (2006) or reported by local landowners. If rattlesnakes are present in the LSA, they are likely present at low densities in localized areas. A species account for the rattlesnake is presented in **Appendix 9**.

9.2 Methods

Field Surveys

Polygons rated High or Moderate suitability for snakes, in proximity to Project footprints areas, were prioritized for field visits, although small unmapped areas were also searched when encountered if they appeared to be suitable. The field crew was composed of two biologists, one of which was an snake biologist experienced in field surveys for hibernacula. The sampling method used was Time-constrained Searches (Resources Inventory Committee (RIC) 1998b). Sampling time depnds on the activity patterns of the species in questions and the thermal conditions of the site. Times of extreme temperature are likely to be unproductive (Resources Inventory Committee (RIC) 1998b). Suitable habitat was searched on foot (**Plate 9-1**), which involved scanning the ground for snakes and shed skins, and turning over cover objects (rocks, logs) in search of snakes. Displaced cover objects were returned to their former positions. Any snakes or shed skins (sheds) observed were identified to species (where possible) and the UTM location of the observation recorded. The amount of time spent searching each area was recorded.

Plate 9-1 Searching for Snake Hibernacula (L. Andrusiak photo)

<u>Habitat Suitability Mapping</u>

The snake habitat ratings were run on the ecosystem map to produce a draft themed map of hibernating habitat as described in Section 3.1. Habitat suitability ratings for Great Basin gophersnake will be made for living in all seasons, which will include habitat used for hibernation, egg-laying and living (habitats used for foraging, cover and thermoregulation; see **Appendix 9** for more details). Habitat suitability ratings for North American racer were modelled for Hibernation and for Living (see **Appendix 9** for more details). Habitat suitability ratings for western rattlesnake were modeled for Hibernation which will include habitats used for hibernation and birthing (which occurs at the opening of the den), and for Living (summer) habitat values, including habitats used for foraging, cover, and thermoregulation in summer (see **Appendix 9** for more details).

9.3 Results

Hibernaculum Surveys

<u>2008</u>

Snake hibernaculum surveys completed in 2008 took place from April 27 to 30 between 09h40 and 18h40. Survey scheduling was delayed due to the cool, late spring of 2008, but even so, the weather was unseasonably cold during the April trip. A follow-up visit was completed on May 9, 2008, when weather conditions were more suitable for snake emergence. Surveys in 2008 were concentrated in potentially suitable rocky outcrops in the Jacko Lake, Ajax East pit and Ajax West pit areas (**Figure 9-1**). The western aspect of Sugarloaf Hill was also surveyed, as snakes could potentially den there. Twelve transects were completed, with three of those (suitable habitat adjacent to the Ajax pits) re-checked on May 9. Total two-person crew survey time in 2008 was 13 hours 37 minutes.

Snakes observed included two adult female and one juvenile common gartersnake (*Thamnophis sirtalis*), and an adult female rubber boa (**Plate 9-2**). The rubber boa was observed on Sugarloaf Hill. Five shed gartersnake skins and one dead gartersnake were also recorded during surveys. No western rattlesnakes, racers or gophersnakes were observed.

Plate 9-2 Rubber Boa (L. Andrusiak photo)

Snake dens are characterized as (M. Sarell, pers. comm. 2008):

- Candidate (good structure but no evidence)
- Confirmed III (good structure but no hard evidence at feature but some snakes in general vicinity)
- Confirmed II (good structure with snakes observed in vicinity)

- Confirmed I (snakes observed in feature at appropriate time of year).

The snake observations resulted in three 'Confirmed II' den locations, and four additional 'candidate' den areas were also located with high suitability but no evidence of snake use (**Plate 9-3**). High-suitability snake hibernating habitat is present adjacent north of and between the Ajax West and East pits. As snake hibernacula are considered sensitive sites, actual locations are not presented here but can be provided on request. Six road-killed snakes (two western terrestrial gartersnakes *Thamnophis elegans* and four common gartersnakes) were also recorded incidentally along the haul road in April, May and August 2008.

Plate 9-3 Candidate Den Near the Ajax Pits (L. Andrusiak photo)

During the bird survey in May 2008, an additional rock outcrop that appeared to provide suitable habitat was located on the edge of the Ajax South Mined Rockpile. That rock outcrop was revisited on August 11, 2008. The outcrop has many deep fissures and suitable aspect, and is located adjacent to a pond where snake prey (Columbia spotted frogs) was observed. A small western terrestrial garter snake and a shed skin were observed near the pond. The outcrop was classified as a snake hibernaculum (Confirmed II) based on its highly suitable structure and the presence of gartersnakes in the vicinity.

<u>2010</u>

Snake surveys in 2010 took place from April 19 to 20 and April 22 to 23, between 09h16 to 17h52. Surveys were conducted under provincial Wildlife Act permit KA08-44016. Total survey time was 15 hours 1 minute.

Eleven survey transects and multiple spot-checks from a vehicle were done on rock outcrops and talus slopes, including Sugarloaf Hill, Coal Hill, the waste rock storage area footprints, and the vicinity of the Ajax open pits. In total, 15 hours were spent on foot transects by the two-person crew. No at-risk snake species were detected. One gartersnake shed was found just north of Jacko Lake, and two subadult western terrestrial gartersnakes were found (**Plate 9-4**), one at the rock outcrop just east of the Ajax pits at the east gate to Goose Lake Road , and one on Sugarloaf Hill.

Plate 9-4 Juvenile Western Terrestrial Gartersnake (L. Andrusiak photo)

2014

Snake surveys in 2014 took place from April 28 to May 2, 2014, between 10h15 to 17h36, and targeted potentially suitable habitat south of Jacko Lake and east of Goose Lake Road that had not been previously surveyed. Ten transects were surveyed, totalling 11 hours 51 minutes of survey time for the two-person crew **(Figure 9-1)**.

One gartersnake den was discovered in spring 2014 by an exploration drilling crew on the side of the haul road on the north shore of Jacko Lake (**Plate 9-5)**. Approximately 20 gartersnakes were reported by the drill crew on April 7, 2014. The site was revisited during the 2014 snake surveys, and five western terrestrial gartersnakes were observed within 5 m of the den on April 29.

No other snakes were observed during transects. The habitat suitability on two transects (SN3 and SN10) was rated up to Moderate for hibernation, and the remaining transects were rated a maximum of Low suitability.

Plate 9-5 Gartersnake Den (arrow) on the Side of the Haul Road North of Jacko Lake (L. Andrusiak photo)

Incidental Snake Detections

Incidental detections of snakes included 23 records of live gartersnakes (*T. sirtalis* or *T. elegans*), 12 road-killed gartersnakes and 1 shed. No other snake species were confirmed.

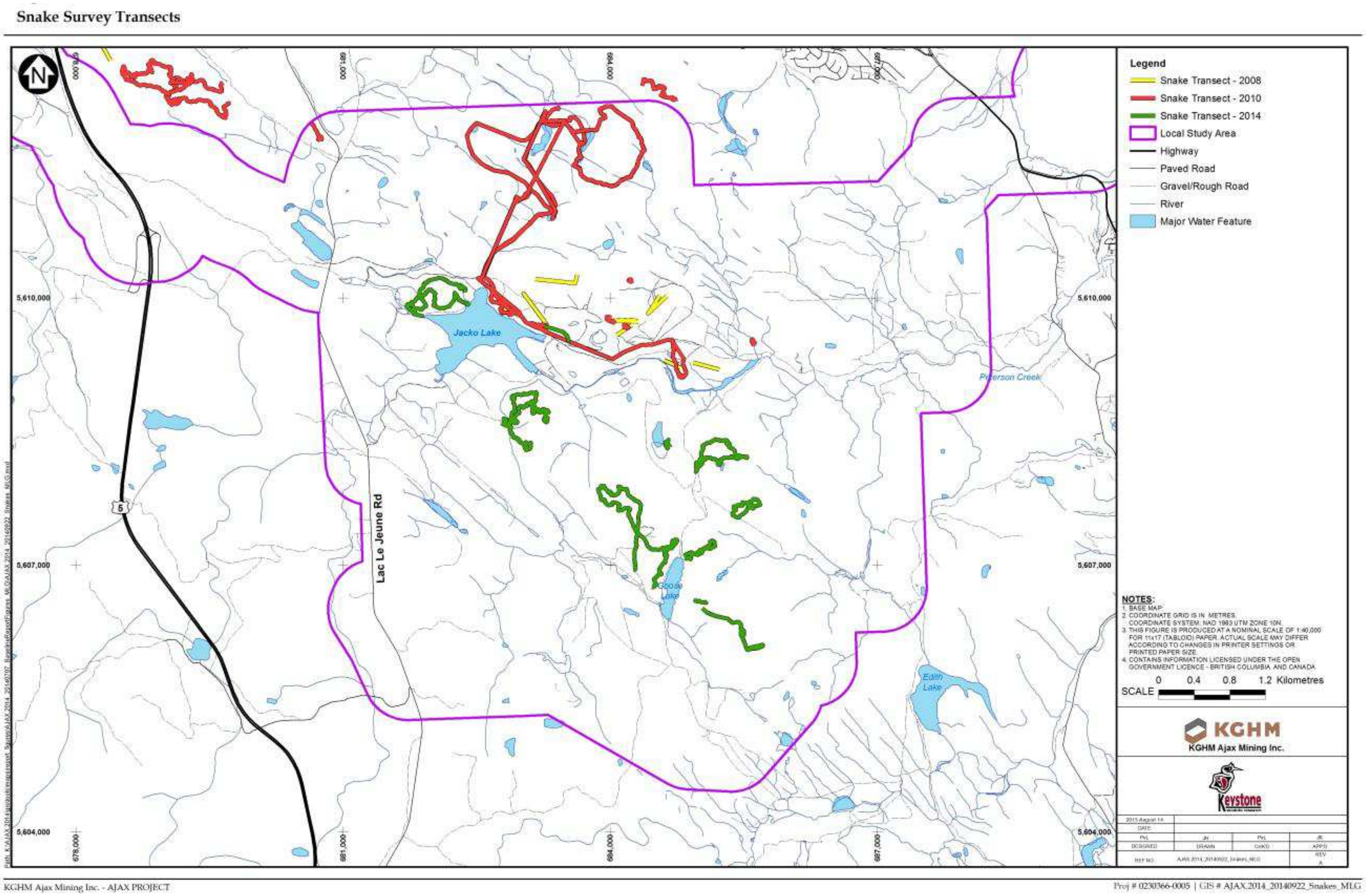


Figure 9-1 Snake Survey Locations

Habitat Suitability Ratings

Great Basin Gophersnake

Over 5,200 ha of moderate-suitability living (all season) habitat was mapped (**Table 9-1**;

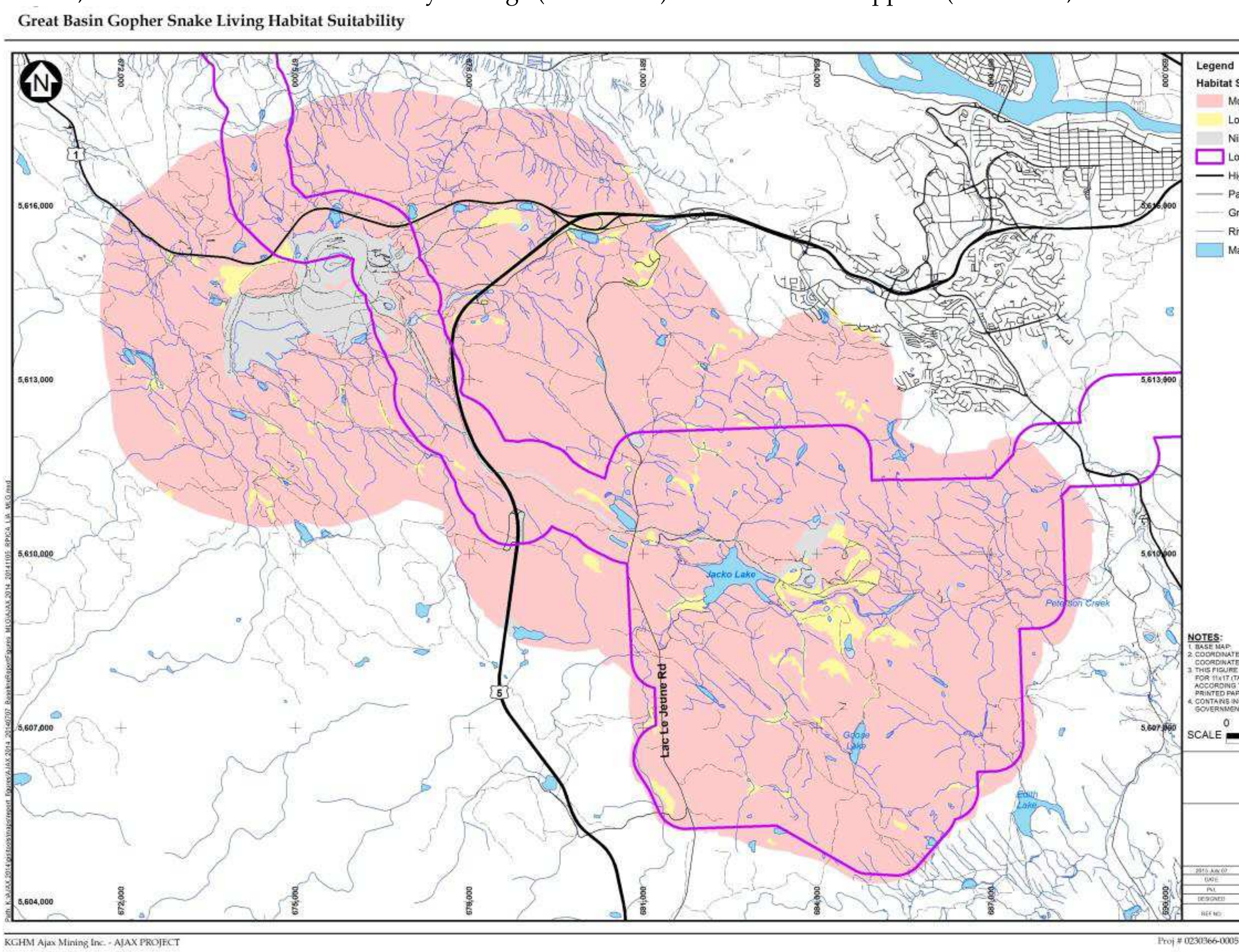


Figure 9-2). The majority of the LSA was rated Moderate, with a few polygons of High suitability habitat scattered about the LSA and outside the LSA on Sugarloaf Hill. Gophersnakes are generalists and would use nearly all habitat types present in the LSA. Although a large amount of apparently suitable habitat is present for the species, no gophersnakes were observed during field surveys.

Table 9-1 Living Habitat Suitability for Great Basin Gophersnake in the TEM Portion of the LSA

Living Suitability	Ha in TEM portion of LSA	% of TEM portion of LSA
Moderate	5,279.3	88.8

Low	263.0	4.46
Nil	401.2	6.8
TOTAL	**5,943.6**	

North American Racer

No high-suitability North American racer habitat is present in the LSA but over 63 ha of moderate-suitability hibernating habitat was mapped in the LSA (**Table 9-2**). Scattered polygons of moderate-suitability hibernating habitat are present (**Figure 9-3**).

Over 3800 ha of moderate-suitability growing-season habitat for racers is present throughout the LSA (**Table 9-2**; **Figure 9-4**). Racers have not been recorded in the LSA.

Table 9-2 Living and Hibernating Habitat Suitability for North American Racer in the TEM Portion of the LSA

Living Suitability	Ha in TEM portion of LSA	% of TEM portion of LSA	Hibernating Suitability	Ha in TEM portion of LSA	% of TEM portion of LSA
Moderate	3,855.7	64.9	Moderate	63.6	1.1
Low	1,643.1	27.7	Low	1,369.2	23.0
Nil	444.8	7.5	Nil	4,510.8	75.9
TOTAL	**5,943.6**		**TOTAL**	**5,943.6**	

Western Rattlesnake

Less than 63 ha of moderate-suitability hibernating habitat was mapped in the LSA (**Table 9-3**). Scattered patches of moderate-rated hibernating habitat are located around the LSA (**Figure 9-5**). Areas of suitable hibernating habitat are also present near the Ajax pits. There is much more Moderate-suitability Living habitat than Hibernating habitat for rattlesnakes in the LSA (**Table 9-3**). Living habitat is distributed across the LSA. Rattlesnakes have not been observed in the LSA.

Table 9-3 Habitat Suitability Ratings for Western Rattlesnake in the LSA

Growing Season Suitability	Ha in TEM portion of LSA	% of TEM portion of LSA	Hibernation Suitability	Ha in TEM portion of LSA	% of TEM portion of LSA
Moderate	4,352.9	73.2	Moderate	62.6	1.0
Low	549.0	9.2	Low	1,280.9	21.5
Nil	1,041.6	17.5	Nil	4,600.1	77.3
TOTAL	**5,943.6**		**TOTAL**	**5,943.6**	

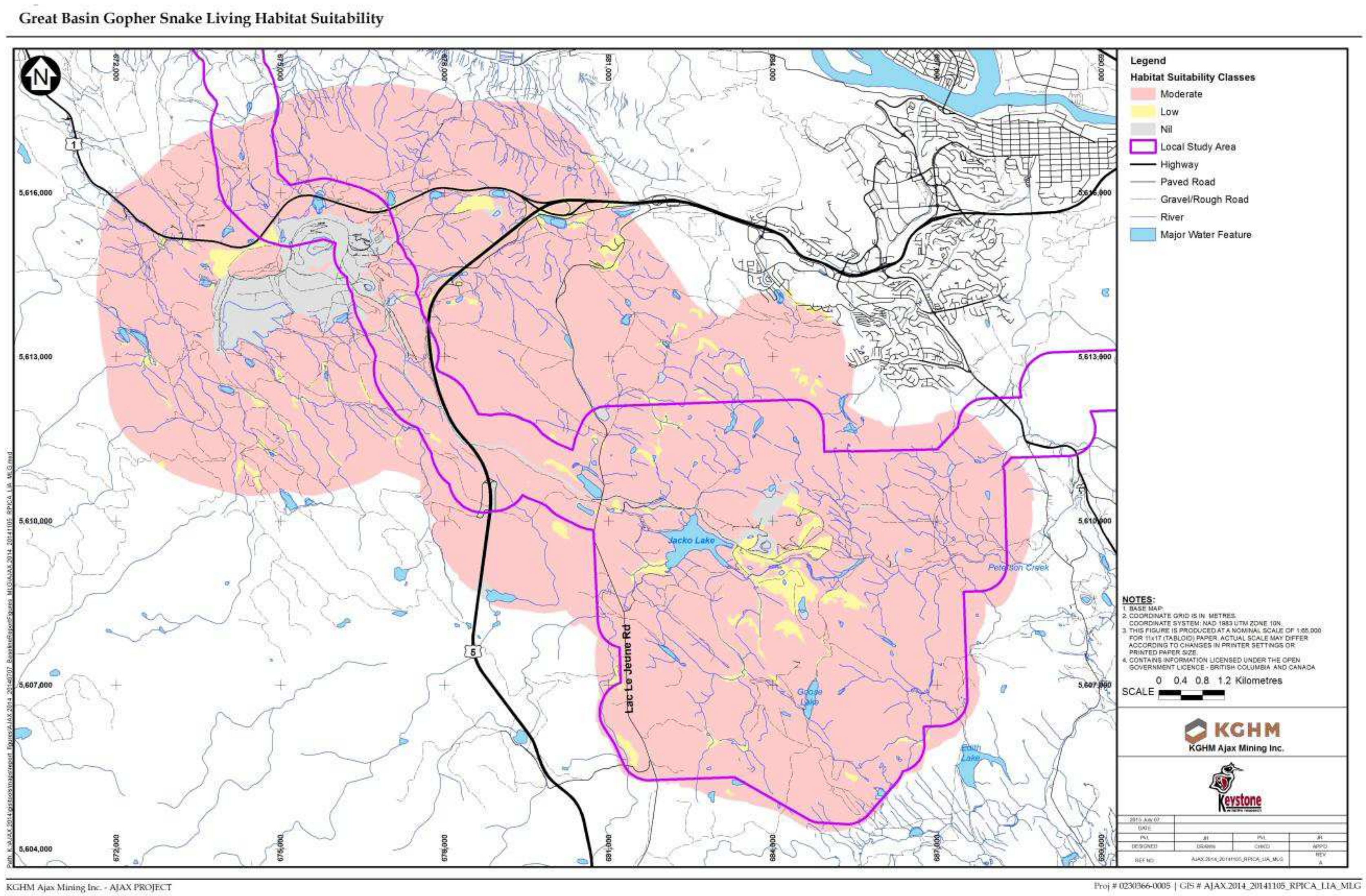


Figure 9-2 Great Basin Gopher Snake Living Habitat Suitability

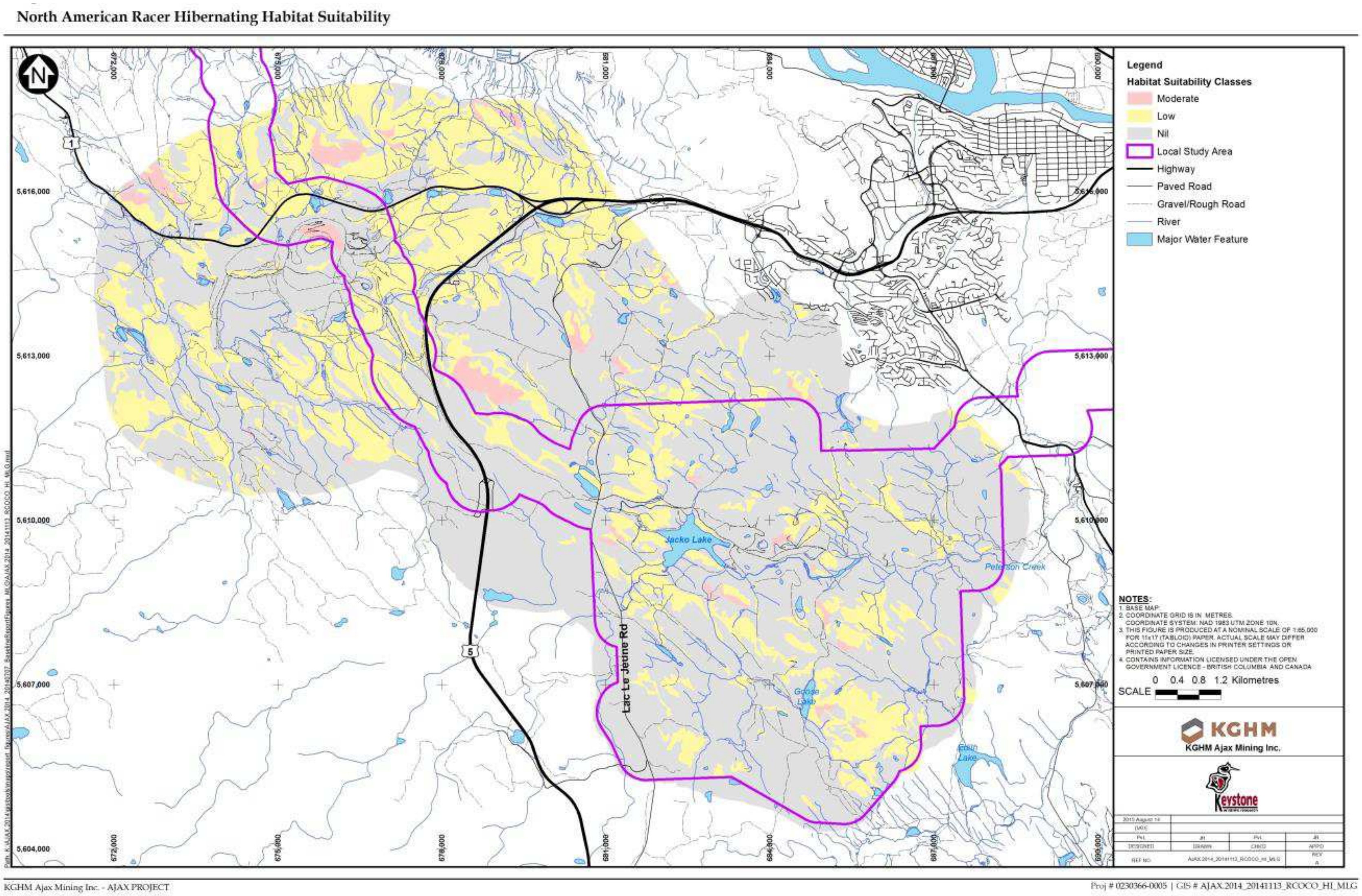


Figure 9-3 North American Racer Hibernating Habitat Suitability

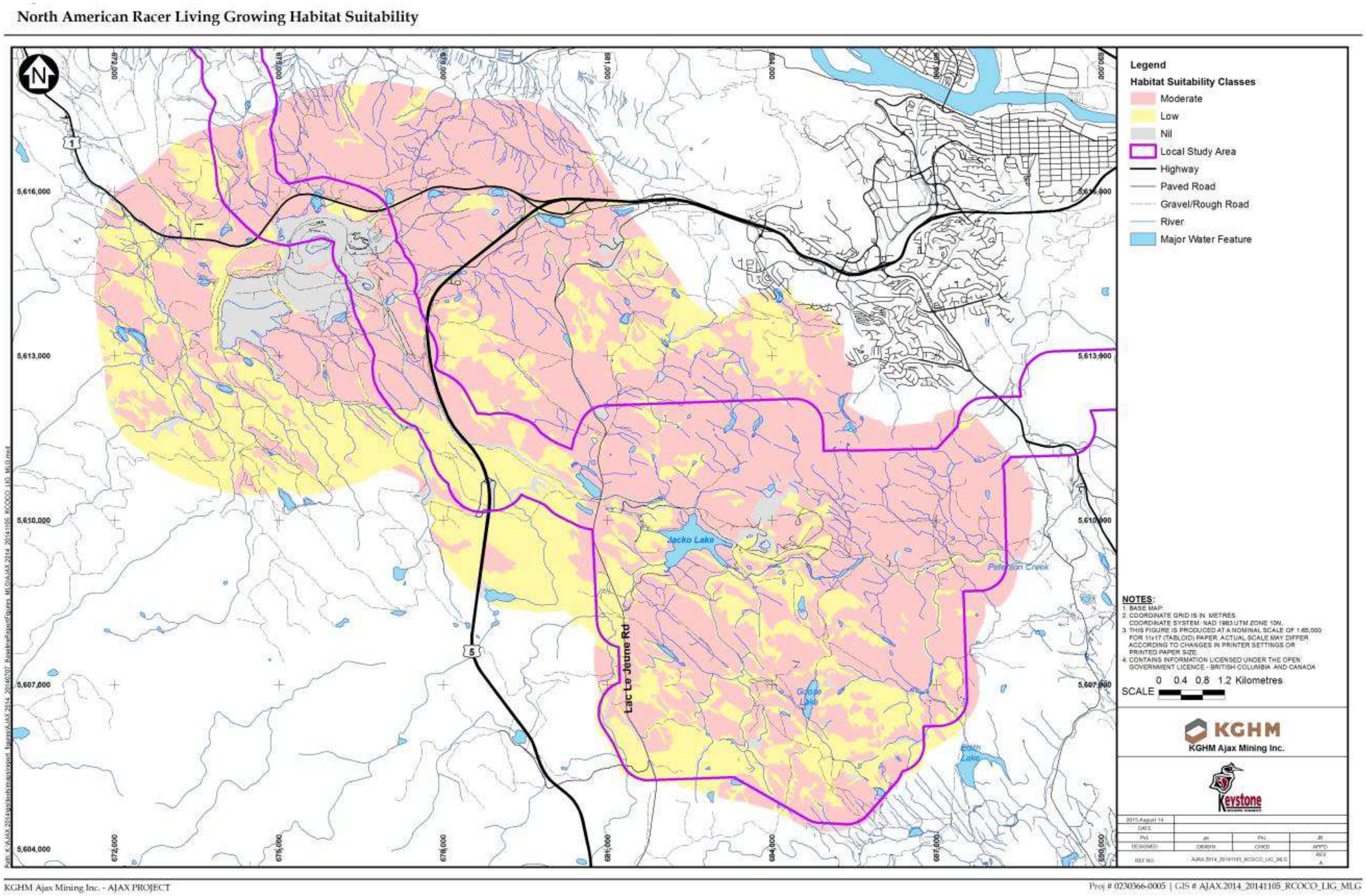


Figure 9-4 North American Racer Growing Habitat Suitability

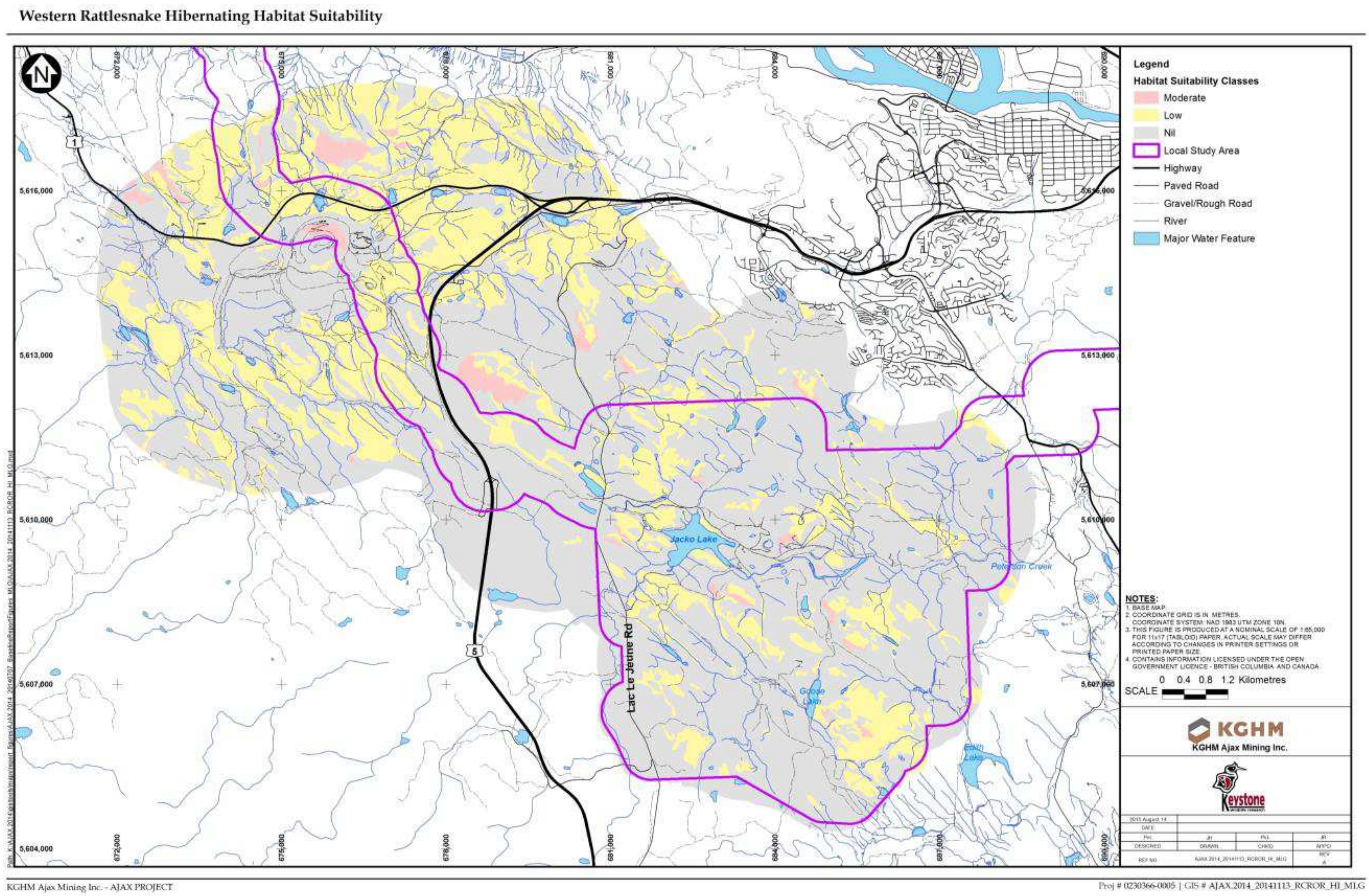


Figure 9-5 Western Rattlesnake Hibernating Habitat Suitability

10.0 AMPHIBIANS

The Great Basin spadefoot, western toad, Columbia spotted frog and Pacific chorus frog are indicator species for the amphibian VC. Brief summaries of their biology are provided below.

10.1 Baseline

Great Basin Spadefoot

The Great Basin spadefoot is a small toad that is adapted to the habitats found in arid regions of BC. Currently, the species is Blue-listed provincially (BC Conservation Data Centre 2014a). It is estimated that at least 10,000 spadefoots live in the province (COSEWIC 2007a); however, as their habitat is one of the most endangered ecosystems in the province, the species is designated as Threatened under SARA's Schedule 1. A provincial recovery strategy has been prepared for the species (British Columbia Southern Interior Reptile and Amphibian Recovery Team 2008).

Spadefoots hibernate during the winter and estivate during particularly dry and hot periods in the summer within underground burrows. They emerge from hibernation in late March or early April and gather at waterbodies to breed. There is a high degree of variation in timing of breeding, both between years and between individuals (Morey 2005). Males can be readily detected by their distinctive call (Resources Inventory Committee (RIC) 2008). There is no evidence of breeding site fidelity (BC Ministry of Water, Land and Air Protection 2004), and most adults are encountered within 800 m of breeding sites (Morey 2005). The eggs hatch in 2-4 days, and tadpoles can metamorphose in as little as 36 days after hatching.

Spadefoots tend to occur in clumps in valley bottoms, where demand for agricultural and residential land is high (Cannings et al. 1999). Since they occur in clumps, their risk of local extirpation is high (*ibid*.). Habitat loss and degradation are the primary threats to spadefoots in the province (COSEWIC 2007a), and changes in habitat that result in a lowering of the water table can cause critical breeding ponds to dry up (Cannings et al. 1999). Spadefoots may be susceptible to chemicals such as pesticides and herbicides, and high mortality from road kill may occur at some migration sites (*ibid*.).

Spadefoots have previously been reported by others at several locations in the RSA including the pond along the highway north of the Crescent-Afton pit (Iredale & Ferguson 2007), and in the existing tailings pond itself (Rescan Environmental Services Ltd 2006). They are capable of breeding in alkaline waterbodies with pH lower than 10, and tadpoles have been reared successfully in water at 27 °C (Morey 2005). Spadefoots could potentially breed in many small ephemeral waterbodies throughout the LSA, but will only be successful at sites where water is retained for at least 36 days after eggs are laid.

Western Toad

The western toad is widespread in British Columbia, occurring from the Rocky Mountains to the Pacific coast (COSEWIC 2012). The species is one of the few amphibians that can inhabit alpine habitats, and it is absent only from the most arid areas. The western toad is provincially Blue-listed, and is designated as a species of Special Concern under Schedule 1 of SARA, mainly due to diminishing habitat and distribution in its North American range (BC Conservation Data Centre 2014a). A provincial management plan has been prepared for western toad (Provincial Western Toad Working Group 2014).

The western toad is primarily terrestrial, and inhabits forested areas, wet shrublands, avalanche slopes and subalpine meadows during the non-breeding season (COSEWIC 2012). Toads typically select habitats that promote water conservation and provide cover from predators (Bartelt et al. 2004). Preferred habitats include moist areas with dense shrub cover, often in close proximity to wetlands. However, toads can also be found in dry forests and grasslands. During very dry periods, toads take shelter in loose soil, animal burrows, moist depressions, tree root tangles and in dense ground cover (Green & Campbell 1984).

Western toads breed in a variety of habitats, including ponds, streams edges, shallow lake margins, ditches, and road ruts (Olson 1992; Corkran & Thoms 1996; Gyug 2000). Aquatic breeding habitats vary considerably in the amount of canopy cover, coarse woody debris and emergent vegetation, but shallow water with a sandy bottom appears to be preferred (Green & Campbell 1984). Eggs are laid in water less than 0.5 m deep, and tadpoles congregate in warm, shallow margins (Corkran & Thoms 1996). COSEWIC (2012) states that wetlands that are relatively shallow and retain water for the three months from early spring until mid to late summer are ideal for breeding.

Declines in western toad populations have been observed throughout their range, including in some relatively 'pristine' areas (COSEWIC 2012). The reasons for these declines are not well understood, but isolation, disease, pesticide poisoning, competition with introduced species (e.g., American bullfrog *Lithobates catesbiana*) and habitat loss resulting from urban development, pollutants, road development and timber harvest are all believed to be contributing factors (Slough 2004; COSEWIC 2012; BC Conservation Data Centre 2014b).

The recently-released management plan for the western toad in British Columbia (Provincial Western Toad Working Group 2014) includes provisions for protection of habitat and maintenance of self-sustaining western toad populations throughout their range. Management objectives outlined in this plan include the identification of important breeding sites throughout the province, clarification of threats and initial actions to mitigate high and moderate impacts to breeding sites, and addressing knowledge gaps, such as metapopulation structure and function, movement patterns, disease, and short-term population trends. Ongoing monitoring of western toads will help to fill in current knowledge gaps for the population stability (*ibid*.).

<u>Columbia Spotted Frog</u>

The Columbia spotted frog inhabits all of British Columbia in areas east of the Coast Mountains (Matsuda et al. 2006). The species is primarily aquatic, inhabiting permanent quiet water and the grassy/sedgy margins of ponds, slow moving streams, lakes, springs and marshes (Matsuda et al. 2006; BC Conservation Data Centre 2014c). Individuals may disperse to adjacent habitat (forest, brush and grassland) in periods of wet weather (Pilliod 2002 in BC Conservation Data Centre 2014a).

Within the southern Interior of BC, breeding begins in early spring from early April to mid-May, typically before surface ice has completely disappeared (Matsuda et al. 2006). Movements of individuals are generally short distances and studies of tagged individuals reported that the majority of all movements documented were less than 300 m from the point of capture (Engle 2001 in BC Conservation Data Centre 2014a).

Northern Pacific Treefrog

The Northern Pacific Treefrog (formerly known as Pacific chorus frog or Pacific treefrog, is found within southern BC and south into the United States. Northern Pacific treefrogs inhabit grassland, open woods, forest, and farmland, excluding areas of extreme dryness (Matsuda et al. 2006; BC Conservation Data Centre 2014a). They live primarily on land and are known to be tolerant of suburban development and farming (Matsuda et al. 2006). Northern Pacific treefrogs use a variety of aquatic habitats to breed including shallow, seasonal or permanent swamps, ponds or slow-moving watercourses (Matsuda et al. 2006; BC Conservation Data Centre 2014a).

Methods

Nocturnal auditory surveys for calling amphibians and daytime searches for egg masses and tadpoles were completed by a two-person crew. Driving (road) surveys were used to search for adults moving to breeding habitat. Surveys for amphibians were carried out according to methods described in RIC (1998f) as summarized below.

Nocturnal Auditory Surveys

Nocturnal auditory surveys also began at dusk and were combined with road surveys. Observers travelling by vehicle stopped at listening stations near waterbodies, waited for one minute after turning off the engine, and then listened for up to 15 minutes for calling amphibians. Any calls heard were noted and identified to species. The location of each listening station was recorded with a handheld GPS unit, and the direction and distance to the calling amphibian was estimated. The number of calling amphibians was estimated, and any amphibians observed visually were also recorded.

Road Surveys

Road surveys started around dusk and were combined with nocturnal auditory surveys. The field crew drove slowly down the Project roads, scanning the road and roadsides for amphibians. If an amphibian was observed, surveyors identified it to species and recorded its location (UTM NAD 83) with a handheld GPS unit. Weather conditions (temperature, wind, cloud cover, time since rain) were also recorded.

Larval Surveys

Wetlands with standing water were surveyed for the presence of egg masses and tadpoles. Surveyors waded into the waterbody and visually scanned for the presence of eggs and/or larvae while systematically moving across the waterbody until the entire shoreline area had been searched. Dip nets were used to sweep through the wetland bottom. Wetland characteristics (size, substrate, emergent vegetation, water temperature) and UTM location were recorded. Any egg masses located or tadpoles captured were identified to species and their locations recorded. Larval surveys were conducted during the daytime.

Results

Nocturnal Auditory Surveys

Amphibian larval surveys, auditory surveys and nocturnal road transects were completed in 2008 (two surveys), 2010 (four surveys) and 2014 (three surveys). Nine nocturnal auditory surveys were completed in total (**Figure 10-1**) for a total survey time of nine hours five minutes (**Table 10-1**).

Table 10-1 Summary of Nocturnal Amphibian Auditory Survey Effort

Date	Number of Stations Surveyed	Total survey time (hhmm)
June 10, 2008	12	00h54
June 11, 2008	9	01h16
May 12, 2010	9	00h46
June 9, 2010	5	01h15
June 10, 2010	3	00h45
June 11, 2010	5	01h35
April 28, 2014	6	00h57
April 29, 2014	10	01h04
April 30, 2014	6	00h33
Grand Total	**65**	**09h05**

Great Basin spadefoots and Northern Pacific treefrogs (**Plate 10-1**) were detected by their characteristic calls during the nocturnal transects (**Table 10-2**; **Figure 10-1**). An adult western toad was visually observed during one transect.

Plate 10-1 Northern Pacific Treefrog (L. Andrusiak photo)

Table 10-2 Results of Amphibian Auditory Surveys

Date	Western toad (visual)	Northern Pacific treefrog	Great Basin spadefoot	Total Estimated
June 10, 2008	1	35	1	37
June 11, 2008		14	2	16
June 10, 2010		0	3	3
June 11, 2010		10	3	13
June 9, 2010		149	5	154
May 12, 2010		122	0	122
April 28, 2014		20	74	94
April 29, 2014		27	124	151
April 30, 2014		13	221	234

Date	Western toad (visual)	Northern Pacific treefrog	Great Basin spadefoot	Total Estimated
Grand Total	1	390	433	824

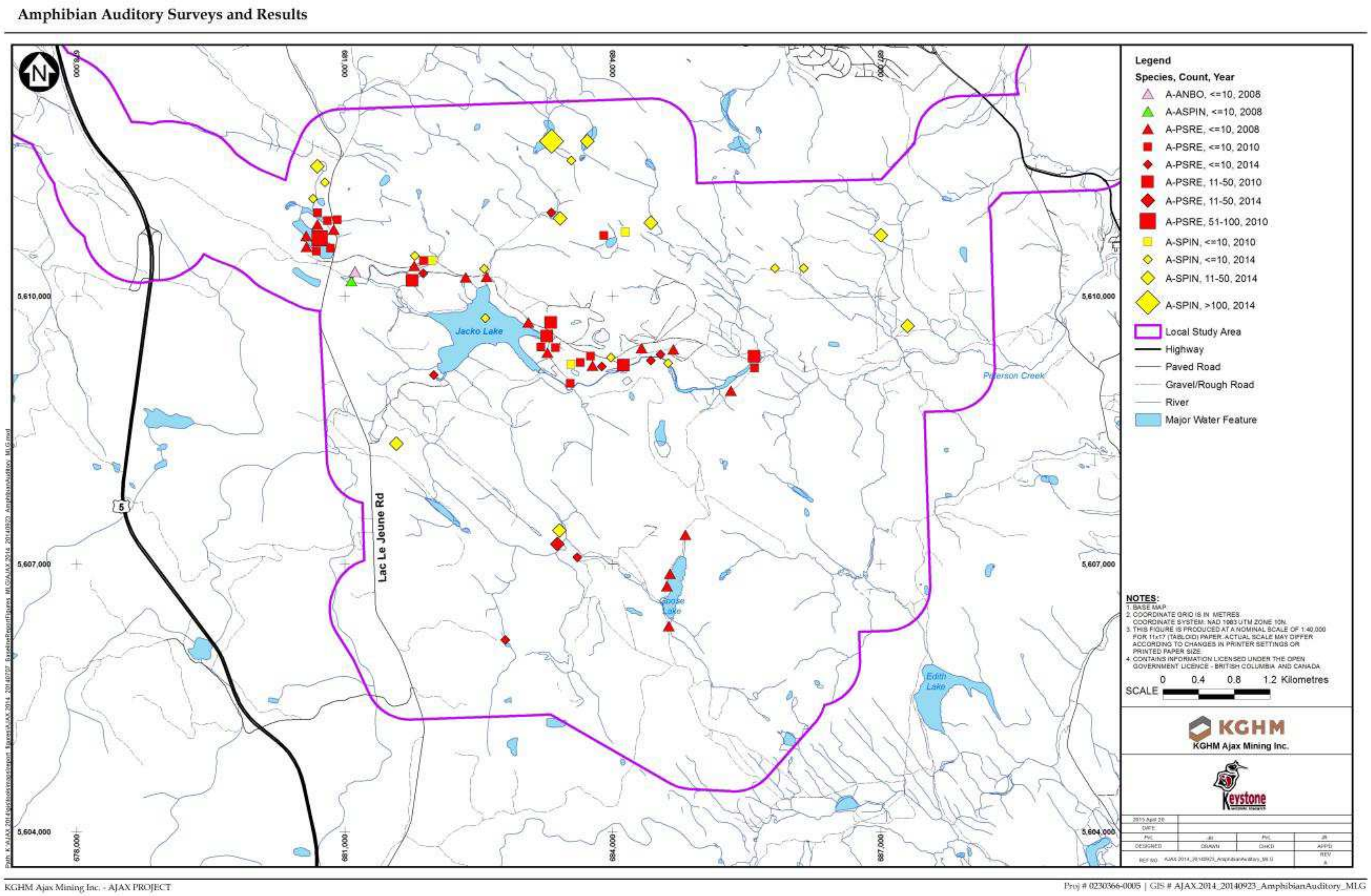


Figure 10-1 Amphibian Auditory Surveys and Results

Road Surveys

In 2010, 9 hours 33 minutes were spent in conducting 49 km of road surveys for amphibians (**Table 10-3**; **Figure 10-2**). Five Great Basin spadefoots (**Plate 10-2)** and seven western toads (**Plate 10-3**) were detected (**Table 10-4**). One roadkilled western toad was observed incidentally, and an adult toad was seen in a puddle at Inks Lake (**Table 10-4**). Western toad tadpoles were seen at the junction of Peterson Creek and Jacko Lake, confirming the wetland arm as a toad breeding site.

Table 10-3 Summary of Amphibian Road Survey Effort

Survey Date	Total Time (hr min)	Length (km)
June 8, 2010	02h06	11.14
June 9, 2010	02h25	10.73
June 10, 2010	03h05	20.20
June 11, 2010	01h57	7.03
Total	09h33	49.09

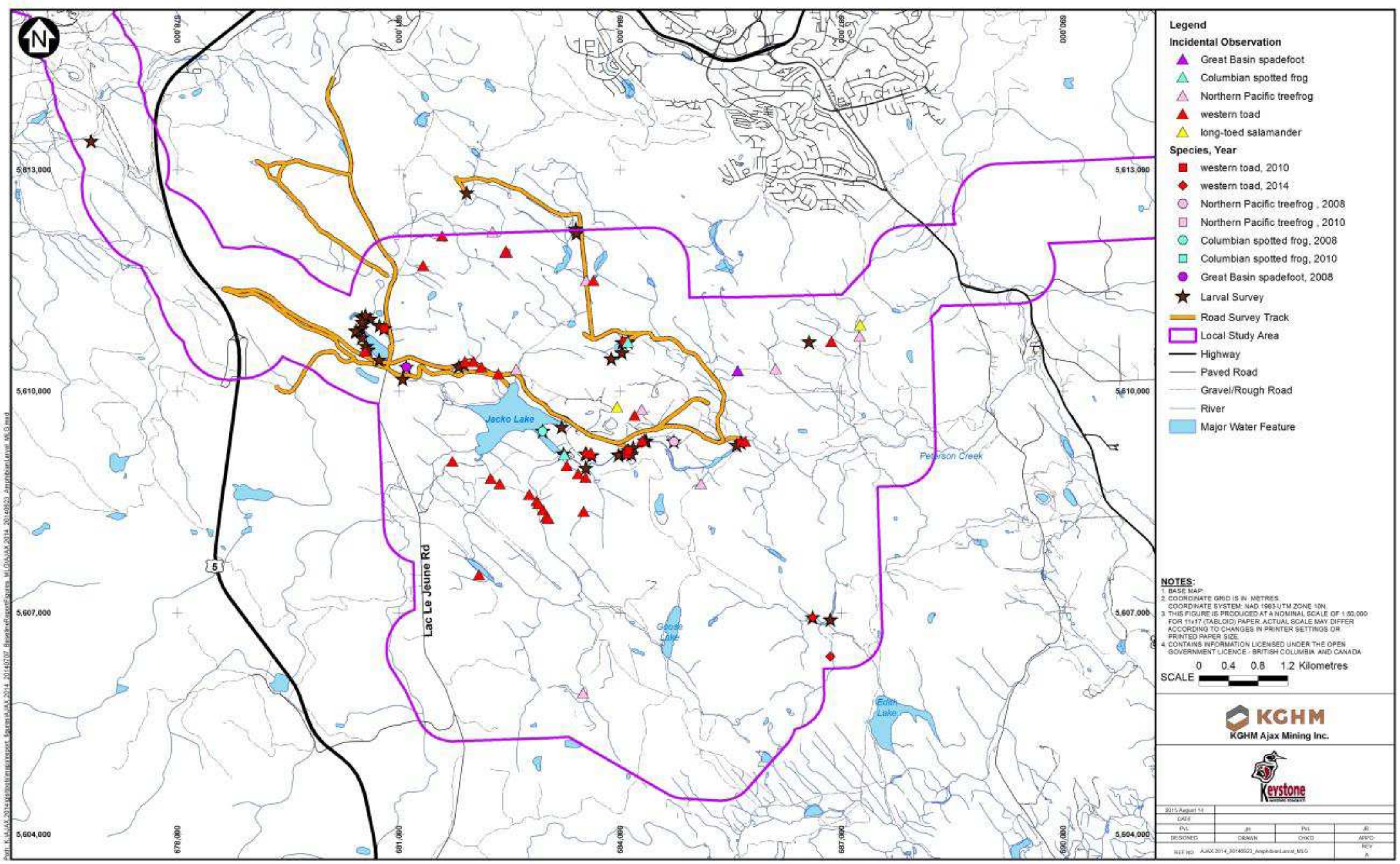
Plate 10-2 Great Basin Spadefoot (L. Andrusiak photo)

Plate 10-3 Western Toad (L. Andrusiak photo)

Table 10-4 Results of Amphibian Road Surveys (also includes incidental amphibian observations)

Date	Species		Total Detected
	Western toad	Great Basin spadefoot	
June 8, 2010	1	0	1
June 9, 2010	2	0	2
June 10, 2010	2	3	5
incidental	1	0	1
June 11, 2010	2	2	4
Total detected	8	5	13

Amphibian Road Transects and Larval Searches and Results



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Proj # 0230366-0005 | GIS # AJAX.2014_20140923_AmphibianLarval_MLG

Figure 10-2 Amphibian Road Transects and Larval Serches and Results (also includes incidental amphibian observations)

Larval Surveys

Thirty-one amphibian larval surveys were done in 2008 to 2014, for a total survey effort of 29 hours 54 minutes (**Table 10-5; Figure 10-2**). It was difficult to survey some waterbodies effectively as heavy cattle use had resulted in deep and glutinous mud around the shoreline and surveyors could not move safely along the water's edge.

Table 10-5 Summary of Amphibian Larval Survey Effort

Date (y/m/d)	Number of Search Points	Sum of Total Search Time (hr min)
June 11, 2008	4	04h34
June 12, 2008	1	00h26
April 14, 2010	1	01h20
May 13, 2010	8	05h14
May 14, 2010	3	03h10
May 15, 2010	2	01h34
May 16, 2010	1	01h20
June 9, 2010	1	02h34
June 10, 2010	3	02h46
June 11, 2010	3	03h54
April 23, 2014	2	0hr52
May 20, 2014	1	0h40
May 22, 2014	1	1hr30
Grand Total	31	29h54

Great Basin spadefoot and Northern Pacific treefrog tadpoles were each observed at one survey point, and mating adult western toads and their egg masses (**Plate 10-4**) were observed at a pond north of the Ajax pits (**Table 10-6; Figure 10-2**). Adult frogs (**Plate 10-5**) and western toads were observed at several other survey points. Western toads were observed opportunistically during other surveys in 2008 (one roadkill on the haul road; one juvenile observed during the snake survey).

Plate 10-4 Western Toad Egg Masses (L. Andrusiak photo)

Table 10-6 Results of Amphibian Larval Surveys

Date	Transect Segment Label	Species	Development Stage				Grand Total
			Adult	Egg mass	Tadpole	Juvenile	
June 11, 2008	W5	Columbia spotted frog	1	0	0	0	1
	W8	Northern Pacific treefrog	0	0	4	0	4
	W9	Great Basin spadefoot	0	0	30	0	1
May 14, 2010	POND10-11	Western toad	5	0	0	0	5
		Northern Pacific treefrog	1	0	0	0	1
		Columbia spotted frog	1	0	0	0	1
May 15, 2010	POND10-13	Western toad	0	0	0	2	2
May 16, 2010	POND10-14	Western toad	0	0	0	7	7
		Columbia spotted frog	2	0	0	0	2

Date	Transect Segment Label	Species	Development Stage				Grand Total
			Adult	Egg mass	Tadpole	Juvenile	
June 10, 2010	2010-Jun-10-Wet3	Western toad	9	6	0	0	15
June 11, 2010	2010-Jun-11-Wet1	Western toad	2	0	0	0	2
April 23, 2014	Wetland24	Western toad	0	0	0	1	1
May 22, 2014	Wetland9	Western toad	19	0	0	0	19
May 22, 2014	Wetland2	Western toad	0	0	0	2	2
Grand Total			40	6	34	12	63

Plate 10-5 Spotted Frog (L. Andrusiak photo)

Incidental Observations

Additional incidental observations of amphibians were made during other surveys. Locations of incidental observations are included on **Figure 10-2.** The spring of 2011 was unusually wet, and many of the temporary waterbodies retained sufficient water to be suitable breeding sites for some time. Western toad and Great Basin spadefoot tadpoles were noted in an intermittent pond north of the Ajax pits, and adult Great Basin spadefoots and western toads were seen on site roads during nocturnal surveys for other species. One intermittent pond northwest of the Ajax pits was drying up and the Great Basin spadefoot tadpoles there would have perished from lack of water a few days after the observation was recorded. Several juvenile western toads were found dispersing from their natal ponds, and Northern Pacific treefrogs were observed in the grasslands of the west waste rock dump footprint and in the rocky outcrops of the pit footprint.

Egg masses of Columbia spotted frogs were observed in Peterson Creek in the spring of 2014 at the bridge at the creek outlet from Jacko Lake. Great Basin spadefoot tadpoles were recorded at Wetland 29 during invertebrate surveys.

11.0 MIGRATORY BIRDS

Migratory birds covered under the *Migratory Bird Convention Act* (1994) include the perching birds (passerines or songbirds), seabirds, shorebirds, ducks, geese, loons, swans, grebes, bitterns and herons, cranes, rails, pigeons and doves, woodpeckers, nighthawks and poorwills, hummingbirds, and kingfishers. Ducks, geese and shorebirds and their eggs are traditional food sources for Aboriginal peoples (First Nations Health Council no date). Indicators included within the Migratory Bird VC are American Bittern, Barn Swallow, Common Nighthawk, Lewis's Woodpecker, Long-billed Curlew, Olive-sided Flycatcher, and Williamson's Sapsucker. Brief summaries of the biology of the indicator species are provided below.

11.1 Baseline

Environment Canada has developed strategic plans for Bird Conservation Regions in Canada. The Project lies within Bird Conservation Region 9 and that strategic plan (Environment Canada 2013) has been summarized below. Bird Conservation Region (BCR) 9 lies in the rain shadow of the Cascade Range to its west, is bounded by the Columbia Mountains in the east, and extends north to the southern edge of the central interior plateau of British Columbia. It contains much of the remaining grasslands, shrub-steppe, and low elevation dry forests in British Columbia.

Two hundred and fifty-nine (259) species of birds regularly breed, overwinter, reside year-round or routinely migrate through the region. It also has a disproportionately high number of bird species considered at risk (Special Concern, Threatened or Endangered) by COSEWIC, the Committee on the Status of Endangered Wildlife in Canada. Species found in the BCR 9 region that are vulnerable due to population size, distribution, population trend, abundance and threats were identified as "Priority Species". Of the 259 species found in BCR 9, 98 were identified as priority species.

Of the habitats present within the Project LSA, the broad habitat categories of greatest concern are herbaceous (grasslands), and wetlands. Herbaceous habitats (grassland, shrub-steppe and agricultural areas) are used by the greatest number of priority species (37), some of which reach the northern limits of their range in the Canadian portion of BCR 9. Wetlands (26 species) are also widely used.

The threats assessment process identifies threats believed to have a population-level effect on individual priority species. Threats from agricultural practices are considered 'very high" for herbaceous habitat classes and high for wetland habitat classes, largely as a result of habitat loss and degradation in the grassland and shrub-steppe habitats of the valley bottoms, but also due to ranching and cattle-grazing practices. Mining is expected to have low magnitude effects to priority species within the coniferous, herbaceous and waterbodies broad habitat classes.

The majority of conservation objectives for BCR 9 relate to maintaining or enhancing habitat quality and quantity. Included in these objectives are the maintenance of the full range of naturally-occurring habitat types, maintaining the quality of existing habitats, and retaining important features on the landscape (e.g., standing dead snags for cavity nesting birds).

American Bittern

The American Bittern is a heron-like wading bird that inhabits dense marsh vegetation. American Bitterns are considered migrants to the province, with only a few birds remaining on the coast year-round (there are no records of winter birds in the interior; (Campbell et al. 1990a). Breeding distribution in the province is sporadic, with most nesting occurring within south or central BC, or in the lower Fraser Valley (*ibid*.). The species is designated provincially as Blue-listed (BC Conservation Data Centre 2014a).

American Bitterns breed in wet areas with dense stands of tall, emergent vegetation, such as cattail, bulrushes and willows, or in areas with tall grasses close to wet areas (Campbell et al. 1990a; Gibbs et al. 1992; Fraser et al. 1999). Solitary pairs build nest-platforms out of reeds, cattails or sedges. Nests are generally placed over shallow water (<20 cm deep), but will occasionally be placed on the ground in dry fields (*ibid*.). Wetland size and availability at the beginning of the breeding season are very important factors for the American Bittern, with larger and more abundant wetlands supporting larger breeding populations (Niemuth & Solberg 2003). Stable water levels within breeding wetlands are also considered important for breeding success (BC Ministry of Water, Land and Air Protection 2004).

The total provincial population is undetermined, but declines in the last 20 years, possibly associated with a loss of wetland habitat, make this a species of concern (Cannings et al. 1987; Fraser et al. 1999). The American Bittern is a secretive species that may use the wetlands of the LSA.

Great Blue Heron

The Great Blue Heron is the largest wading bird in North America. Two subspecies are known to occur in the province: *A. h. fannini,* which is found on the west coast from Washington to Alaska, and *A. h. herodias*, which is found across most of North America (BC Ministry of Water, Land and Air Protection 2004). Both subspecies are provincially Blue-listed (BC Conservation Data Centre 2014a). Great Blue Herons are found in the province year-round, although much of the interior population migrates south in the winter (Campbell et al. 1990a; Gebauer & Moul 2001). Breeding begins in late March for *A. h. herodias*, with eggs being laid anytime between April and early July

(Campbell et al. 1990a; Gebauer & Moul 2001; BC Ministry of Water, Land and Air Protection 2004; Vennesland & Butler 2011).

Herons require an abundant and accessible food supply within 10 km of the breeding colony; therefore, proximity to suitable foraging habitat is the primary factor in colony site selection (Gibbs 1991; Butler 1997; Gebauer & Moul 2001). Suitable foraging areas during the breeding season include aquatic areas such as lakeshores, marshes, ponds, sloughs, slow-moving rivers, wetlands, lagoons, and irrigation ditches (Campbell et al. 1990a; Vennesland & Butler 2011). No breeding colonies are known in or near the LSA.

Lewis's Woodpecker

Lewis's Woodpecker is a woodpecker associated with riparian and open pine forests (primarily ponderosa pine). Its core breeding range is the Thompson Basin and Okanagan Valley (Cooper et al. 1998). The species is provincially Red-listed, and listed on SARA's Schedule 1 (BC Conservation Data Centre 2014a). A federal recovery plan has been proposed for the species (Environment Canada 2014a).

Lewis's Woodpecker is migratory in BC, with birds generally found in the province only between April and the end of September (BC Ministry of Water, Land and Air Protection 2004). Lewis's Woodpeckers feed on insects, nuts, fruits and berries. Characteristics of good habitat for this species include open forest stands with snags and defect trees, with abundant shrubby vegetation to provide a source of insects. Riparian stands of mature and old cottonwood are favoured, as are recent burns (BC Ministry of Water, Land and Air Protection 2004). Cavity nests have been recorded primarily in ponderosa pine and cottonwood, in both living and dead trees (BC Ministry of Water, Land and Air Protection 2004).

Lewis's Woodpecker populations are thought to be threatened by the loss of mature cottonwood and ponderosa pine stands (BC Ministry of Water, Land and Air Protection 2004) due to urban development, snag removal, firewood cutting and the impacts of mountain pine beetle (Environment Canada 2014a). Habitat suitability around Kamloops is Low (Environment Canada 2014a). A species account and ratings table has been prepared for Lewis's Woodpecker (see **Appendix 9**).

Williamson's Sapsucker

Williamson's Sapsucker is a woodpecker that is a rare summer resident in the province (COSEWIC 2005). The *thyroideus* subspecies is currently Red-listed provincially, and is listed on SARA's Schedule 1 as Endangered (BC Conservation Data Centre 2014a). Williamson's Sapsuckers arrive in the province in late March and depart in mid-September (Campbell et al. 1990b). The species mainly occupies coniferous forests, although it has also been found in mixed forest types (COSEWIC 2005). Williamson's Sapsuckers feed on insects (especially ants) captured from dead and dying trees, and on sap from living trees

Nest trees in BC are mainly large, decadent western larch, Douglas-fir and ponderosa pine (BC Ministry of Water, Land and Air Protection 2004). Both live and dead trees are used, although live trees must have heart rot to accommodate a nesting cavity. Conifers used for nesting are usually >50 cm dbh (*ibid*.). The main threat to Williamson's Sapsucker is the removal of forests, primarily through harvesting activities (Fraser et al. 1999). A pair of Williamson 's Sapsuckers was reported at Jacko Lake in 1994 and 1995 (BC Conservation Data Centre 2007).

Barn Swallow

The Barn Swallow is a migratory swallow that feeds aerially on flying insects. The species is Blue-listed provincially (BC Conservation Data Centre 2014a). The Barn Swallow is well distributed across the province and occupies areas up to at least 2400 m in elevation (Campbell et al. 1997). It tends to forage over waterbodies, fields and wherever else flying insects occur (*ibid*.). Barn Swallows arrive in the Kamloops area from wintering areas in Central and South America in April and typically depart by the end of September (Howie 2004).

Barn Swallows often nest in anthropogenic structures such as barns, bridges, and outbuildings, as well as natural sites such as tree cavities and cliffs (Campbell et al. 1997). Birds will frequently return to the same nesting area and sometimes the same nest year after year (*ibid*.).

Barn Swallow numbers are thought to be declining in the province, perhaps due to changes in farming practices that result in fewer suitable nest sites (Campbell et al. 1997). Parasitism by blowflies can also cause considerable mortality of nestlings (*ibid.*).

Long-billed Curlew

The Long-billed Curlew is BC's only curlew species. It is provincially Blue-listed and listed on SARA's Schedule 1 as a species of Special Concern (BC Conservation Data Centre 2013b). Approximately 500 curlews are thought to be present in the province (COSEWIC 2011b). The Long-billed Curlew is associated with large, contiguous areas of grassland habitats in the BC interior (BC Ministry of Water, Land and Air Protection 2004). This species breeds in the vicinity of Kamloops and may be present from April through June (Howie 2004).

Curlews are migratory and return to their nesting territories in dry, open grasslands in early spring (BC Ministry of Water, Land and Air Protection 2004). Eggs are laid in ground nests in April and May. Prime curlew nesting habitat includes large areas of gently sloped grasslands with short grasses and abundant insect prey. Fall migration is completed in August (Cannings 1995). Cheatgrass (*Bromus tectorum*) is tolerated on nesting areas as long as grazing keeps the grass shorter than 10 cm, but areas of knapweed are avoided (BC Ministry of Water, Land and Air Protection 2004). Threats to curlews and their habitat include grassland habitat loss due to urbanization and intensive agriculture, and habitat degradation from forest encroachment, heavy livestock grazing and all-terrain vehicle (ATV) use (BC Ministry of Water, Land and Air Protection 2004).

Olive-sided Flycatcher

The Olive-sided Flycatcher is a large member of the family Tyrannidae. This species inhabits coniferous forests across much of North America (Altman & Sallabanks 2012). It is Blue-listed, listed on Schedule 1 of *SARA*, and designated as Threatened by COSEWIC (BC Conservation Data Centre 2013b). Olive-sided Flycatchers are present in the Kamloops area between May and early September (Howie 2004).

The Olive-sided Flycatcher is a breeding visitant to BC (Campbell et al. 1997). During the breeding season, it is strongly associated with coniferous forest openings and forested wetlands (COSEWIC 2007b). In particular, wetlands or forests that have been burned or logged and that contain scattered veteran trees or patches are preferred for nesting and perching while foraging (*ibid.*). During foraging, a prominent location (*e.g.,* the top of a dead tree), often serves as a perch from which they can fly catch (Fitzpatrick 1978; Wright 1997).

Olive-sided Flycatcher populations have declined in North America over the past 40 years (COSEWIC 2007b). Provincial trends have been more difficult to assess due to smaller sample size, but there appear to be consistent declines across most provinces (*ibid.*). The cause of this decline is unknown, but loss of winter habitat, the increasing presence of ecological sinks in breeding habitat, or a reduction in insect prey due to pesticides have all been suggested (Diamond 1991; Hutto & Young 1999; Altman & Sallabanks 2012).

Common Nighthawk

The Common Nighthawk is an insectivorous bird with mottled grey-brown plumage (BC Conservation Data Centre 2013b). It is found across all regions of the province except the central and north coasts, and in all BGC zones except those in the alpine. The species is provincially Yellow-listed, is listed on Schedule 1 of SARA, and is designated as Threatened by COSEWIC (*ibid*.).

Nighthawks usually forage aerially on flying insects at dawn and dusk, although during inclement weather they will also forage during the day. Foraging occurs above nesting habitat as well as above wetlands, rivers, ponds and estuaries, generally between <1 m above water and up to 80 m above forested areas (Brigham 1990). Flocks of foraging nighthawks are not uncommon where insect densities are high, especially during the fall when large numbers of birds may congregate to feed on swarming termites (Campbell et al. 2006; COSEWIC 2007c).

Birds roost singly or occasionally in groups (males) in a variety of habitats. Known roost sites include open forests, fence posts, buildings, transmission towers, the ground, and beach logs. Individual birds may return to the same roost site repeatedly (Campbell et al. 2006).

Females arrive on breeding sites in the spring about a week ahead of the males. They begin nesting shortly after the males' arrival (Campbell et al. 1990b), when the males court females with aerial and ground displays. Breeding males are territorial and defend areas varying in size from 4 to 28 ha (Campbell et al. 2006).

Nesting habitats are open, sparsely vegetated areas, often surrounded by forest. Females choose nesting substrates that will enable them to remain well-camouflaged. Areas used for nesting include burns, clearcuts, open pine (*Pinus* spp.) and aspen forests, sagebrush (*Artemisia* spp.), prairie, rock outcrops, gravel roofs in urban areas, dunes, beaches, grasslands, pastures, peat bogs, marshes, lakeshores, roadsides, reclaimed mines and river banks, in sites with little to no vegetation (Campbell et al. 1990b, 2006; COSEWIC 2007c; Ontario Ministry of Natural Resources 2009; Brigham et al. 2011). Preferred sites have patchy herb, forb or grassy understories interspersed with bare soil (Campbell et al. 2006).

Females may exhibit some degree of nest site fidelity (COSEWIC 2007c). Eggs have been found in BC from May to August (Campbell et al. 1990b), but most eggs are laid in late June through July (Campbell et al. 2006). One to four eggs (usually two) are laid and incubated by the female for 16-20 days, and fledging occurs at 18-20 days (Fowle 1946; Campbell et al. 2006; Brigham et al. 2011). Nests and young in cultivated areas are susceptible to trampling by livestock and crushing by farm machinery (Campbell et al. 2006). Nesting takes about 40 days from egg-laying to fledging (*ibid*.). The adults will tend the young for up to 30 days and they may join with migrating flocks at 52 days (Dexter 1952). Migration to wintering areas in South America begins in mid-August (COSEWIC 2007c).

Sandhill Crane

The Sandhill Crane is a large, long-legged bird that is provincially Yellow-listed and is an Identified Wildlife species (BC Conservation Data Centre 2013b). This species nests, roosts and forages on the ground and often uses coniferous forests for cover (BC Conservation Data Centre 2013b). Sandhill Cranes eat a variety of foods including roots, tubers, seeds, grain, berries, small mammals and birds, snakes, earthworms, and insects (BC Conservation Data Centre 2013b).

Sandhill Cranes migrate in flocks to breeding areas in wetlands, bogs, marshes, swamps, meadows and estuaries across the province in April. Migration routes and stopover sites (wetland edges, dry rangelands, grain fields) are traditionally-used (Blood & Backhouse 1999). The Knutsford area is known as a stopover site for migrating cranes (Blood & Backhouse 1999). The primary migration period through Kamloops is April and September-October (Howie 2004).

Nesting territories are generally remote and free of human disturbance and are 20-80 ha in size (*ibid*.). One to three eggs are laid in April to May. Juveniles migrate with their parents in September or October and will remain in the family group for 8 to 9 months. Sandhill Cranes are known to breed in the Kamloops vicinity (Howie 2004).

Waterfowl

Species assessed in the 'waterfowl' group include loons, grebes, ducks, geese and swans. This indicator also includes non-waterfowl species of shorebirds and marsh birds. As evidenced by their name, this group includes species that are closely-associated with waterbodies. Food habits are very variable. Some birds (e.g. loons, mergansers) specialize on fish, while others such as Mallards (*Anas platyrhynchos*) have a broad diet of aquatic invertebrates, vegetation, mollusks, insects and seeds.

Some species in this group build floating nests on waterbodies, while others nest in dense cover along the shore. A few shorebird species build no nest at all but simply lay their eggs on the ground in open areas, trusting to the eggs' colouring to camouflage them from predators. Some ducks (e.g. Bufflehead *Bucephala albeola*) nest in tree cavities close to water.

11.2 Methods

Breeding Bird Surveys and Migration Surveys

Breeding bird surveys are normally requested by federal reviewers for most impact assessments. Sampling methodology followed that described in *Inventory Methods for Forest and Grassland*

Songbirds (Resources Inventory Committee (RIC) 1999c) for simple point counts and encounter transects. Nesting calendars for the Kamloops area (BCR10 – A1a) indicate early May to mid-July as the optimal time (Environment Canada 2014). Transect routes were identified on hardcopy maps prior to surveys based on accessibility (e.g., road access), habitat diversity and Project footprints. An effort was made to sample representative ecosystem units and structural stages and areas of potential disturbance.

Transects were laid out at least 200 m apart, with point count stations on each transect at least 200 m apart. The surveys took place during the morning, in the first 4 hours after sunrise. At the beginning and end of each survey, wind (Beaufort factor), cloud cover, temperature (degrees Celsius), and precipitation type were recorded according to RIC standards. Any changes in these environmental conditions were noted throughout the survey. The start and end time at each survey were also recorded.

A GPS was used to determine station position in NAD83 UTM co-ordinates. At each point count station, any birds seen or heard during a five-minute listening period were noted. Any significant incidental bird observations made while travelling between stations were recorded, as were locations and descriptions of any nests found.

Surveys of birds on migration were carried out using point count methods similar to those described above for breeding bird surveys. The timing for these migration surveys was April and August. The methods for the migration surveys differed from those of the breeding bird surveys in that surveys took place from dawn until noon.

Waterfowl Surveys

Observation stations were used to survey waterfowl species. All surveys were carried out according to the provincial *Inventory Methods for Waterfowl and Allied Species* (Resources Inventory Committee 1999a). All bird species observed during surveys were recorded, including waterfowl, water-associated birds, raptors and songbirds.

Observation stations were completed at ponds and lakes. In the event that a wetland was not completely surveyed, the percentage of the wetland that was surveyed was recorded for each wetland. Each lake or pond was surveyed one or more times depending on the site's accessibility and the suitability of the habitat. Waterfowl and other birds on the waterbody were identified to species and sex (where apparent) and recorded on standard data sheets.

Waterfowl and shorebird species were also observed during surveys targeting other species groups. Those incidental observations were recorded and have been used in the generation of the Project's species list.

Woodpecker Surveys

Call-playback surveys were conducted during the breeding season to survey for Williamson's Sapsucker, as described in *Inventory Methods for Woodpeckers* (Resources Inventory Committee 1999b) and other specific standards for Williamson's Sapsucker Inventory (Forest Investment Account 2006). Call-playback surveys are recommended by RIC (1999b) as the most effective method for determining presence/not detected or relative abundance of woodpeckers during the breeding season.

Sapsucker transects were established to sample habitat units that corresponded to high-quality habitat, thus focusing effort on strata that have the highest potential population levels. Accessibility to survey routes was also a factor in determining transect locations. Call-playback stations were placed along transects at 250 m intervals, however limited information exists on woodpecker territory sizes, so RIC (1999b) does not recommend a specific inter-station distance along transects.

A crew of two persons conducted call-playback. At each station, the wind (Beaufort factor), cloud cover, temperature (degrees Celsius), and precipitation type were recorded according to RIC standards. Surveys did not take place in temperatures >28 °C (1999b). The start and end time of each station were recorded, as well as the number of minutes spent at each station. A GPS was used to record station position in NAD83 UTM co-ordinates.

At each station, observers arrived and waited for one minute prior to beginning broadcasting, in order to listen for spontaneous sapsucker calls or drumming. If no sapsuckers were observed, pre-recorded sapsucker calls were broadcast for 20 seconds, followed by a 30-second break. This was repeated three times for each station (e.g. 20/30, 20/30, 20/30) for a total of 2.5 minutes (60 seconds of calls and 1.5 minutes listening) per station.

Surveys for Lewis's Woodpecker used stand-watch methodology. Stand-watches were completed in areas of apparently suitable habitat. Observers remained at the survey location for 15 minutes, watching and listening for sounds of Lewis's Woodpecker activity. Any woodpeckers detected were recorded on standard data sheets.

American Bittern Surveys

Call-playback surveys for American Bittern were carried out according to methods described in RIC (1998c). Preliminary locations for call-playback stations were laid out at apparently suitable habitat using satellite imagery. Surveys were carried out between 30 minutes before sunrise and four hours after sunrise by a crew of two surveyors. After arriving at each station, surveyors listened for two minutes to detect any spontaneously calling birds, then played three repetitions of a 20-second recording of American Bittern vocalizations followed by thirty seconds of listening (**Plate 11-1**). Survey station locations and weather conditions were recorded on standard data sheets.

Plate 11-1 Call-playback Surveys for American Bittern

Common Nighthawk Surveys

Call-playback surveys for Common Nighthawk were carried out according to methods described in RISC (1998g). Surveys began at sunset and ended at civil twilight (approximately two hours later). Call-playback stations were separated by 500 m. Two surveyors drove along Project roads, stopping at playback stations and playing pre-recorded Common Nighthawk calls (including male territorial 'booming'). Each station began with one minute of listening time to detect birds already present, then 5 to 6 calls were played followed by 30 seconds of listening time. The playback and listening time were repeated twice more, followed by another minute of listening, for a total station time of five minutes. If nighthawks were already present and calling when surveyors arrived at the station, calls were not played in order to minimize disturbance to the birds. The distance and direction of the calling birds were recorded and the surveyors moved to the next station.

Any nighthawks heard or seen were recorded, along with the compass direction and estimated distance to the bird(s), and weather conditions at each station. Birds that were booming were recorded as males, and birds that were silent or calling were recorded as unknown sex.

Habitat Suitability Mapping

Habitat suitability mapping was prepared for Williamson's Sapsucker and Lewis's Woodpecker as described in Section 3.1. Habitat suitability ratings for Williamson's Sapsucker models Reproducing-Eggs (RE) and foraging (FD) habitats. These life requisites occur in similar habitats at the 1:20,000 scale, and are therefore modeled as the living (LI) life requisite. Breeding (nesting) occurs during the spring and foraging can extend from April to September, therefore living is modeled for the growing season (see **Appendix 9** for more details). Habitat suitability ratings for Lewis' Woodpecker models Reproducing-Eggs, which is satisfied by the presence of suitable nesting habitat (see **Appendix 9** for more details).

11.3 Results

Breeding Bird Surveys and Migratory Bird Surveys

Six point count transects for breeding birds were completed in 2007, four in 2008, four in 2010 and seven in 2014 (**Table 11-1; Figure 11-1**). Each transect was at least 1 km long (i.e. included at least 6 point count stations), for a total of 361 point count stations. Two transects (one in 2008 and one in 2007) were done in the RSA outside the LSA. One transect (#4) in 2014 was not completed on its initial survey due to unsuitable weather, so this transect was re-surveyed. Breeding bird point counts were completed May 22 to 23 and June 6 to 7 in 2007, June 7 to 10 in 2008, May 14 to 17 in 2010, and May 10 to 23 in 2014.

Table 11-1 Summary of Breeding Bird Point Count Survey Effort

Visit Date	Transect Label	Total Point Counts
May 23, 2007	A	6
May 23, 2007	B	7
May 24, 2007	C	6
May 24, 2007	D1	7
June 7, 2007	D2	10
June 7, 2007	E	6
June 7, 2008	MT	11
June 7, 2008	TP	19
June 8, 2008	MC	20
June 9, 2008	PD	21
May 14, 2010	PC	31
May 15, 2010	PCB	21
May 16, 2010	PCC	19
May 17, 2010	PCD	20
May 5, 2014	5	18
May 7, 2014	2	30
May 9, 2014	7	20
May 10, 2014	4	6
May 20, 2014	2	30
May 21, 2014	4	20
May 22, 2014	1	10
May 22, 2014	6	7
May 23, 2014	3	16
Total Point Counts		**361**

In total, 85 species were detected (excluding raptors, grouse, waterfowl, water birds and shorebirds, which are reported elsewhere). Five species listed as Threatened by COSEWIC were detected: species included Barn Swallow (Blue-listed), Bank Swallow, Common Nighthawk, Lewis' Woodpecker (Red-listed) and Olive-sided Flycatcher (Blue-listed) (**Table 11-2**). The Black-billed Magpie, Black-capped Chickadee, Common Raven, Gray Jay, Northern Flicker, Pileated Woodpecker, Sandhill Crane, Western Meadowlark, and Winter Wren are also birds of concern due to traditional First Nations use (Ignace 2014).

Breeding activity (nests, eggs or juveniles) was documented for Northern Flicker, Mountain Bluebird, American Robin, Vesper Sparrow (**Plate 11-2**), Western Meadowlark, Marsh Wren, Red-winged Blackbird, Yellow-headed Blackbird (**Plate 11-3)**, Barn Swallow, and Black-backed Woodpecker.

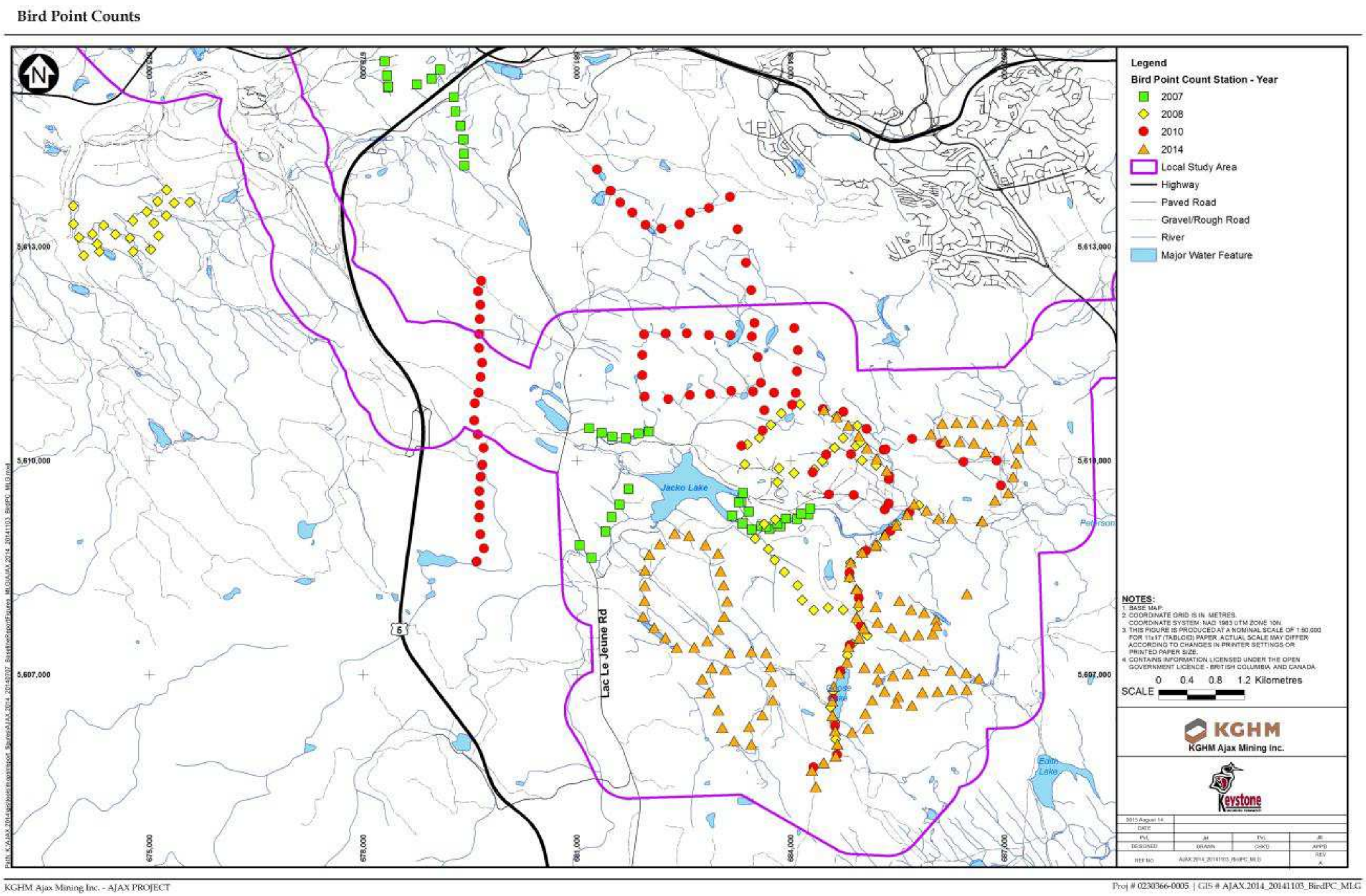


Figure 11-1 Bird Point Count Stations

Table 11-2 Species Detected on Breeding Bird Point Counts, All Years, and on 2014 Migrant Surveys

English Name	Total Detected on Breeding Bird Counts	Total Detected on Migrant Counts
American Crow	30	1
American Pipit	0	80
American Goldfinch	13	0
American Robin	267	119
Anna's Hummingbird	1	0
Barn Swallow*	2	9
Black-billed Magpie[FN]	41	26
Black-backed Woodpecker	1	0
Black-capped Chickadee[FN]	18	34
Brown-headed Cowbird	83	0
Bank Swallow*	7	0
Brewer's Blackbird	31	20
Bullock's Oriole	21	0
Cassin's Finch	33	26
Calliope Hummingbird	3	0
Cassin's Vireo	8	0
Chestnut-backed Chickadee	2	0
Clay-colored Sparrow	18	0
Cedar Waxwing	5	0
Chipping Sparrow	206	8
Clark's Nutcracker	12	9
Cliff Swallow	28	0
Common Nighthawk*	1	0
Common Raven[FN]	58	55
Common Yellowthroat	14	1
Dark-eyed Junco	65	6
Downy Woodpecker	7	1
Dusky Flycatcher	36	10
Eastern Kingbird	15	12
European Starling	107	153
Evening Grosbeak	18	0
Fox Sparrow	1	0
Golden-crowned Kinglet	16	34
Golden-crowned Sparrow	2	0
Gray Jay[FN]	1	1

English Name	Total Detected on Breeding Bird Counts	Total Detected on Migrant Counts
Hammond's Flycatcher	20	1
Hairy Woodpecker	13	3
House Finch	1	0
Horned Lark	4	0
House Wren	25	1
Least Flycatcher	1	0
Lewis's Woodpecker*	2	0
Lincoln’s Sparrow	0	3
MacGillivray's Warbler	8	0
Marsh Wren	37	2
Mountain Bluebird	78	42
Mountain Chickadee	141	73
Mourning Dove	5	0
Nashville Warbler	0	1
Northern Flicker[FN]	141	66
Northern Waterthrush	1	0
Northern Rough-winged Swallow	7	0
Orange-crowned Warbler	24	0
Olive-sided Flycatcher*	8	0
Pine Siskin	28	13
Pileated Woodpecker[FN]	1	3
Purple Finch	2	0
Red-breasted Nuthatch	122	37
Ruby-crowned Kinglet	99	14
Red Crossbill	15	33
Red-naped Sapsucker	18	32
Rock Pigeon	4	0
Rock Wren	2	0
Rufous Hummingbird	4	0
Red-winged Blackbird	103	138
Sandhill Crane[FN]	1	55
Savannah Sparrow	162	34
Song Sparrow	20	3
Swainson's Thrush	2	5
Townsend's Solitaire	37	3
Townsend's Warbler	1	0
Tree Swallow	266	0
Vesper Sparrow	414	205
Violet-green Swallow	11	0
Warbling Vireo	18	3

English Name	Total Detected on Breeding Bird Counts	Total Detected on Migrant Counts
White-breasted Nuthatch	3	1
White-crowned Sparrow	54	67
Western Kingbird	3	0
Western Meadowlark[FN]	281	150
Western Tanager	41	0
Willow Flycatcher	30	0
Wilson's Warbler	15	0
Winter Wren[FN]	1	0
White-throated Sparrow	1	0
Western Wood-Pewee	33	5
Yellow Warbler	34	5
Yellow-headed Blackbird	66	20
Yellow-rumped Warbler	171	93
Total Observations	3750	1715

*listed species [FN]First Nations concern

Plate 11-2 Vesper Sparrow Nest

Plate 11-3 Yellow-headed Blackbird at Jacko Lake (L. Andrusiak photo)

Migrant surveys were completed during the spring and fall migration periods of 2014, using the same transects laid out for the breeding bird point counts. Surveys took place April 22 to 26 and August 25 to 27 (**Table 11-3**). Weather and logistical constraints prevented the fall re-surveys of two transects that had been surveyed during the spring.

Table 11-3 Survey Effort for Birds on Migration

Survey Date	Transect Label	Total Point Counts
April 22, 2014	4	20
April 23, 2014	2	30
April 23, 2014	6	7
April 24, 2014	7	20
April 25, 2014	3	10
April 25, 2014	5	18
April 26, 2014	1	10
August 25, 2014	2	30
August 25, 2014	6	7
August 26, 2014	3	9

Survey Date	Transect Label	Total Point Counts
August 26, 2014	5	18
August 27, 2014	7	20
		199

Forty-nine species were detected on the migration surveys (**Table 11-2**). Species detected on migrant counts that were not detected during breeding bird point counts included American Pipit *Anthus rubescens* (80 observed during migration) and Nashville Warbler *Oreothlypis ruficapilla* (1 detected on migration).

Large flocks of Sandhill Cranes (140-150 birds) were observed flying over the RSA on migration, primarily during the last week of April in 2008 and again in 2014. No cranes were observed landing in the LSA but multiple crane tracks were noted in the mud around alkaline ponds in the grasslands north of the Ajax pits. A list of species detected on the bird surveys and incidentally during other work is presented in **Appendix 7.**

Waterfowl Surveys

Named waterbodies surveyed included Bowers Lake, Ironmask Lake, Pothook Lake, Inks Lake, the existing Afton tailings pond (Hughes Lake), Wallender Lake, Polygon Pond, Jacko Lake and Goose Lake, as well as a number of unnamed temporary and permanent waterbodies (**Figure 11-2**). One hundred fifty-one survey stations were done in total over all years of sampling. Twelve stations were sampled in 2007, 11 stations were sampled in 2010, 35 in 2013 and 93 stations in 2014 (including repeat surveys). Forty waterfowl/shorebird/water bird species (**Table 11-4**) were detected during the waterfowl surveys. One Blue-listed waterfowl species was recorded during waterfowl surveys – four Cackling Goose observed at Wetland 7 on April 1, 2014. Waterfowl, shorebirds and water birds were also observed during breeding bird surveys but only one additional species was detected; Virginia Rail. The species most commonly sighted during waterfowl surveys included American Coot, Barrow's Goldeneye, Bufflehead (**Plate 11-4**), Canada Goose, Greater Scaup, Mallard, Pied-billed Grebe, and Ring-necked Duck. Breeding activity (nests, eggs or juveniles) was documented for Mallard, Canada Goose, Killdeer (**Plate 11-5**), Bufflehead, Cinnamon Teal, Green-winged Teal, Lesser Scaup, Pied-billed Grebe, Red-necked Grebe, Ring-necked Duck, and Sora. Spotted Sandpiper nesting was observed incidentally. The Common Loon and Swans are waterfowl species of concern to the Stk'emlups people (Ignace 2014).

Two listed waterfowl/water bird species were recorded incidentally. Two Cackling Geese were sighted flying over Jacko Lake in a mixed flock with Canada Geese on March 10, 2012. A Great Blue Heron was seen flying over Peterson Creek April 30, 2008 and another heron was observed on June 7 of the same year, also near the creek. Unconfirmed observations of the Long-billed Curlew (Blue-listed) were noted. Single calls of a Long-billed Curlew were heard on two occasions, though the bird itself could not be visually confirmed and its call was not repeated. All bird species observed during all field surveys are listed in **Appendix 7**.

Table 11-4 Numbers of Waterfowl Surveys on Which Waterfowl/Shorebird/Water Bird Species were Recorded (All Years)

Common Name	Scientific Name	Total Surveys Observed *		
		Jacko Lake (26 surveys)	Goose Lake (14 surveys)	Other (111 surveys)
American Coot	*Fulica americana*	16[b]	0	7 [b]
American Wigeon	*Anas americana*	4	4	36
Barrow's Goldeneye	*Bucephala islandica*	21[b]	7	37
Baird's Sandpiper	*Calidris bairdii*	0	1	0
Bufflehead	*Bucephala albeola*	10[b]	10[b]	42[b]
Blue-winged Teal	*Anas discors*	3	2	12[b]
Cackling Goose**	*Branta hutchinsii*	0	0	1
Canada Goose	*Branta canadensis*	8	7[b]	35
Canvasback	*Aythya valisineria*	0	0	3
Cinnamon Teal	*Anas cyanoptera*	2[b]	1[b]	12
Common Goldeneye	*Bucephala clangula*	1	3	4
Common Loon[FN]	*Gavia immer*	5	0	0
Common Merganser	*Mergus merganser*	1[b]	0	0
Eared Grebe	*Podiceps nigricollis*	2	0	0
Eurasian Wigeon	*Anas penelope*	0	0	1
Gadwall	*Anas strepera*	4	4	13
Greater Scaup	*Aythya marila*	0	2	10
Greater Yellowlegs	*Tringa melanoleuca*	0	1	2
Green-winged Teal	*Anas crecca*	1	5	28[b]
Hooded Merganser	*Lophodytes cucullatus*	2	0	1
Horned Grebe	*Podiceps auritus*	3	1	0
Killdeer	*Charadrius vociferus*	0	7	27
Lesser Scaup	*Aythya affinis*	6[b]	2	23
Lesser Yellowlegs	*Tringa flavipes*	1	1	0
Mallard	*Anas platyrhynchos*	8[b]	11[b]	63[b]
Northern Pintail	*Anas acuta*	0	1	8
Northern Shoveler	*Anas clypeata*	1	2	13[b]
Pied-billed Grebe	*Podilymbus podiceps*	13[b]	1	3[b]
Red-breasted Merganser	*Mergus serrator*	0	0	1
Redhead	*Aythya americana*	0	3	10
Red-necked Grebe	*Podiceps grisegena*	9[b]	0	0
Ring-necked Duck	*Aythya collaris*	10[b]	5	21
Ruddy Duck	*Oxyura jamaicensis*	9[b]	0	11
Sora	*Porzana carolina*	0	0	2[b]
Solitary Sandpiper	*Tringa solitaria*	0	0	2
Spotted Sandpiper	*Actitis macularius*	1	3	6
Trumpeter Swan[FN]	*Cygnus buccinator*	0	1	0
Western Sandpiper	*Calidris mauri*	0	1	0
Wilson's Phalarope	*Phalaropus tricolor*	0	0	1
Wilson's Snipe	*Gallinago delicata*	0	0	3

*superscript 'b' indicates juveniles or nesting documented **Blue-listed [FN] First Nations concern

Plate 11-4 Bufflehead Brood (L. Andrusiak photo)

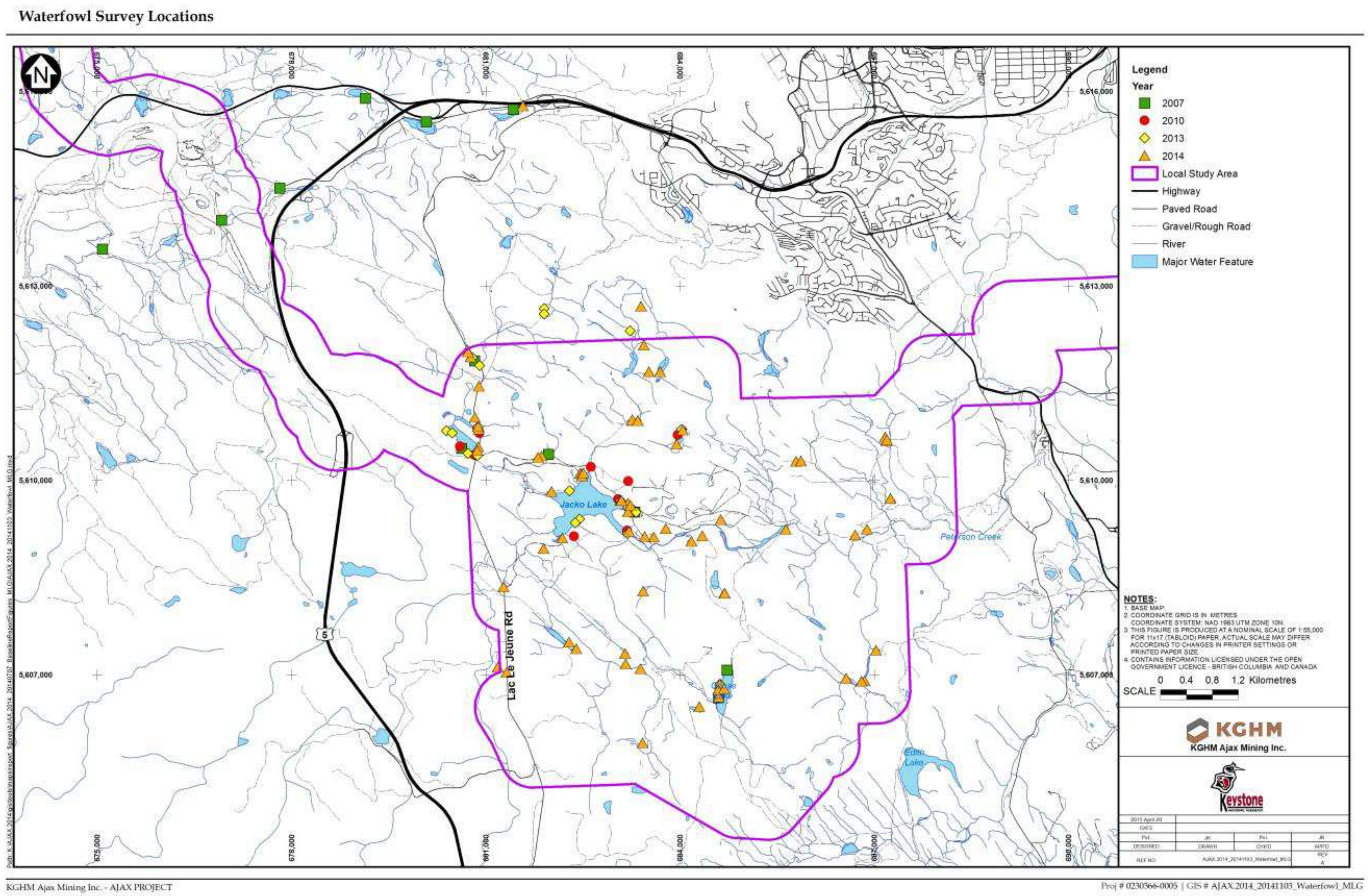


Figure 11-2 Waterfowl Survey Locations

Plate 11-5 Killdeer Nest (L. Andrusiak photo)

A list of waterfowl, shorebirds and water birds that were documented during migration was prepared by refining the species list in **Table 11-4** to include only those species observed on surveys in the migration period, excluding the main breeding period for wetland birds in the Great Basin region (April 16-July 27) (Environment Canada 2014b). Species present during the migration period are presented in **Table 11-5**. Jacko Lake, Inks Lake and Goose Lake were still mostly or entirely frozen at the beginning of April in 2014, but were open by April 23. Wallender Lake appeared to thaw earlier, perhaps because of its higher salinity. Wallender was used heavily by waterfowl while the other lakes were still frozen (e.g. 152 Green-winged Teal and 51 American Wigeon on March 31, 2014) but was rarely used once other waterbodies were available. The species with the largest numbers seen during migration included Lesser Scaup, Green-winged Teal, American Wigeon, Bufflehead, Northern Shoveler, American Coot and Mallard. Those species were all recorded in numbers of 30 or more in a single observation during the migration period, and were sighted mostly on Jacko, Wallender or Inks Lake.

Table 11-5 Waterfowl, Shorebird and Water Bird Species Detected on Waterfowl Surveys During the Migration Period (All Years)

Common Name
American Coot
American Wigeon

Common Name
Barrow's Goldeneye
Bufflehead
Blue-winged Teal
Canada Goose
Canvasback
Cackling Goose
Common Goldeneye
Common Loon
Common Merganser
Gadwall
Greater Scaup
Green-winged Teal
Hooded Merganser
Killdeer
Lesser Scaup
Lesser Yellowlegs
Mallard
Northern Pintail
Northern Shoveler
Pied-billed Grebe
Redhead
Ring-necked Duck
Red-necked Grebe
Ruddy Duck
Solitary Sandpiper
Trumpeter Swan
Wilson's Snipe

Woodpecker Surveys

Three Lewis's Woodpecker stand-watches were completed in 2007, and an additional two in 2008 (Figure 10.1-3), for a total stand-watch time of 1 hour 29 minutes. Stand-watch site locations were chosen based upon the presence of apparently suitable habitat in proximity to project activity areas. No Lewis's Woodpeckers were detected during stand-watches but one bird was observed flying north of the Ajax pits and another single bird was observed opportunistically near the existing tailings pond during breeding bird surveys in June 2008. Little suitable habitat (mature ponderosa pine or black cottonwood forest with a high density of standing snags) is present in the LSA, although scattered large snags are available in grasslands and in young forest.

One hundred twenty-four Williamson's Sapsucker call playback stations were completed in total in 2007, 2008, 2010 and 2011 (**Figure 11-3**), for a total survey time of 11 hours and 18 minutes (**Table 11-6**). Both road transects and spot-checks of suitable patches of habitat were done. One Williamson's Sapsucker was detected in 2007 along Peterson Creek, on the east side of Goose Lake Road. A bird tentatively identified as a Williamson's Sapsucker was observed in June 2008 during breeding bird surveys north of the Ajax East pit, but this individual was only glimpsed momentarily and could not be positively confirmed by the birder. Other woodpeckers recorded during the playback surveys included Downy Woodpecker (**Plate 11-6**), Hairy Woodpecker, Northern Flicker, and Red-naped Sapsucker.

Table 11-6 Summary of Williamson's Sapsucker Call-Playback Survey Effort

Transect/Spot-check Label	Date	Sum of Total Time (hr:min)	Total Stations
SPOT1-SPOT5	June 26, 2006	00h56	5
WISA1	June 27, 2007	00h34	8
WISA2	July 7, 2007	00h10	2
	July 8, 2007	01h15	12
WISA_2008	June 7, 2008	00h51	10
	June 9, 2008	00h24	4
	June 10, 2008	00h53	9
WISA10-A	May 12, 2010	01h20	8
WISA10-B	May 15, 2010	01h10	14
WISA10-C	May 16, 2010	00h55	11
2011-04-27_WISA	April 27, 2011	00h50	11
2011-04-28_WISA	April 27, 2011	02h00	30
Total		11h18	124

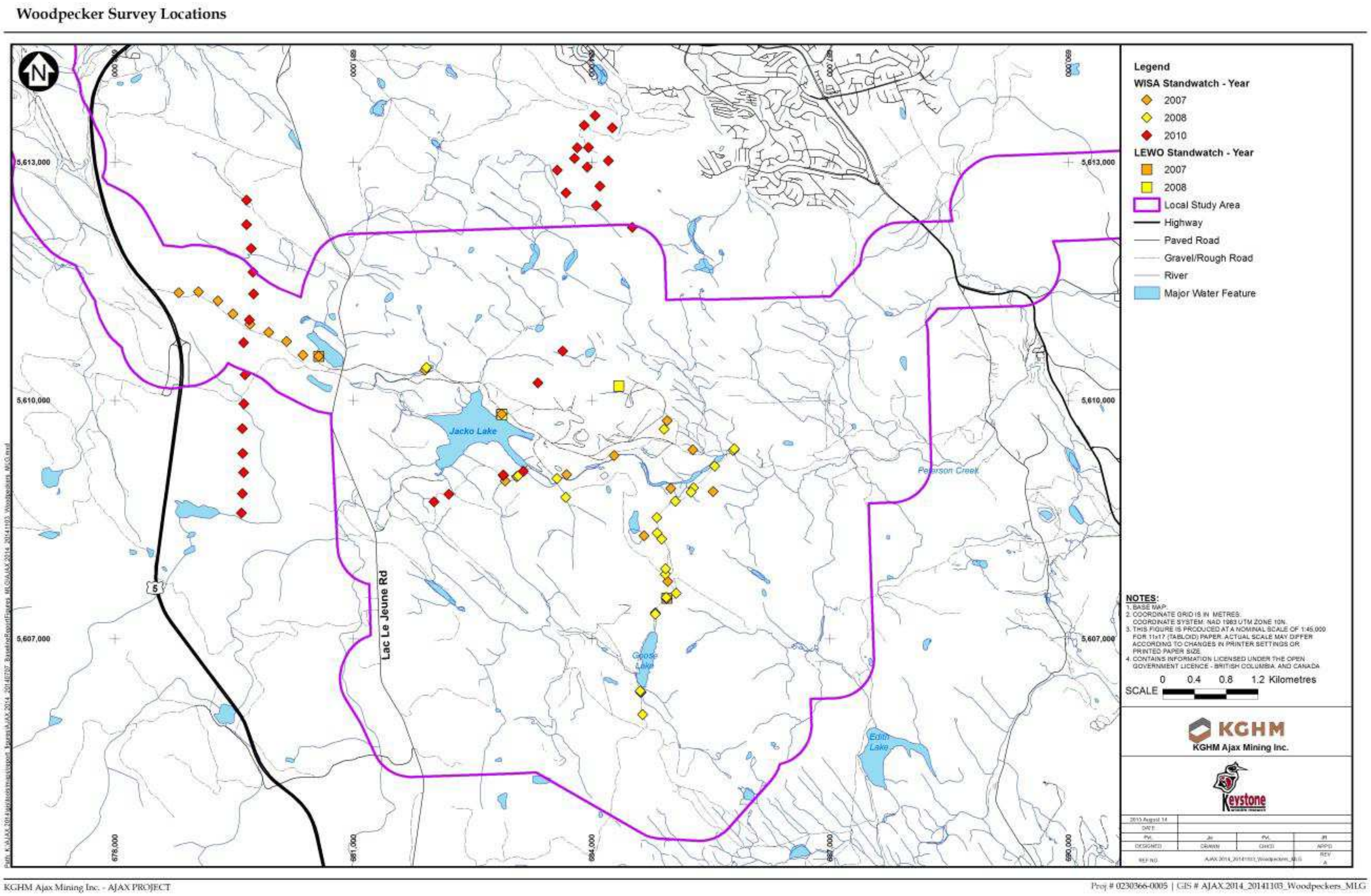


Figure 11-3 Woodpecker Survey Locations

Plate 11-6 Downy Woodpecker (L. Andrusiak photo)

American Bittern Surveys

Call-playback surveys for American Bittern took place June 11 and 12, 2014, and were repeated on June 25, 2014. Surveys were not repeated at station #11, as the habitat was poor. Seventeen stations were surveyed (**Figure 11-4**) for a total survey time of three hours twenty-two minutes. No American Bitterns were detected.

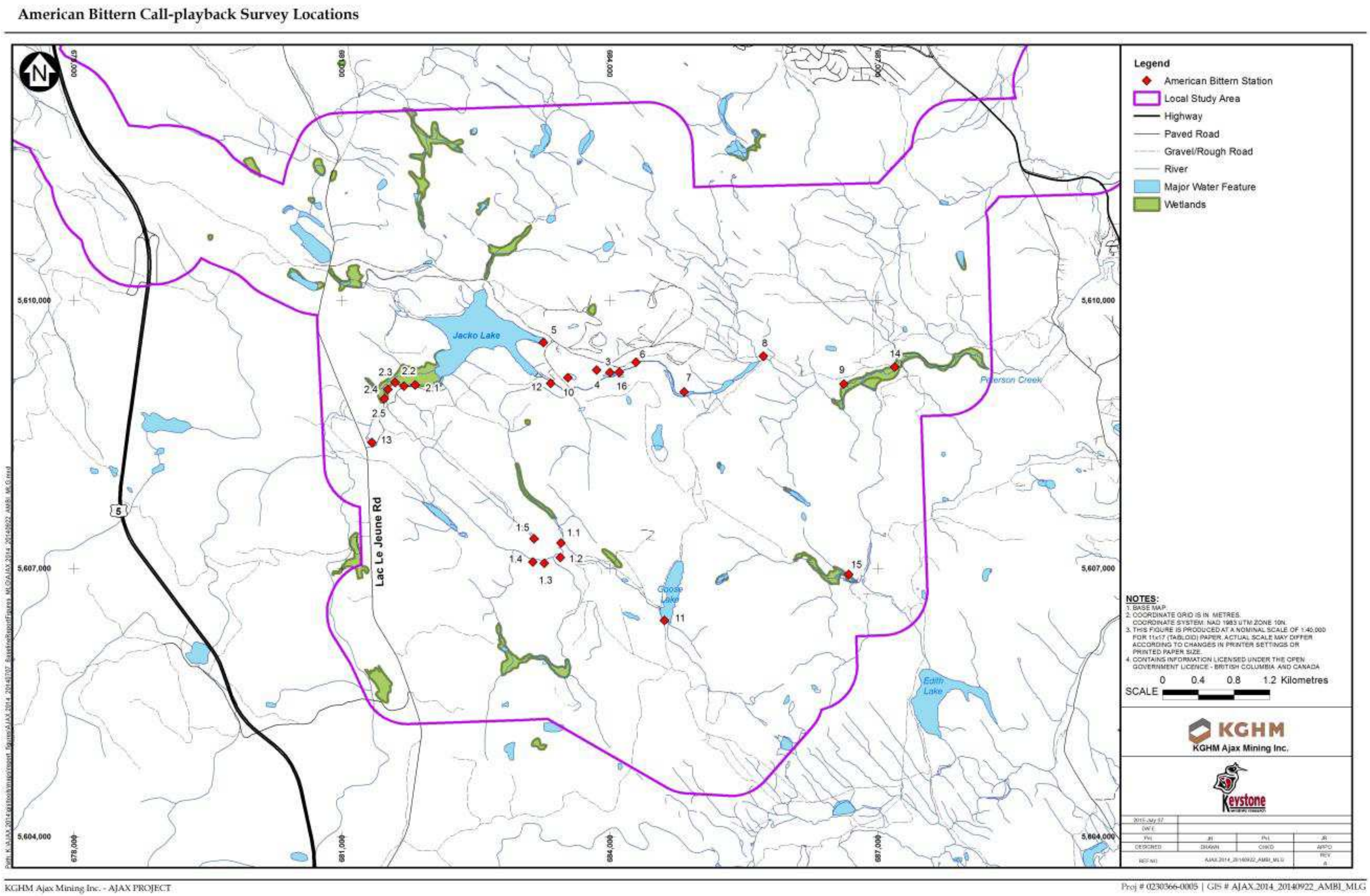


Figure 11-4 American Bittern Call-playback Survey Locations

Common Nighthawk Surveys

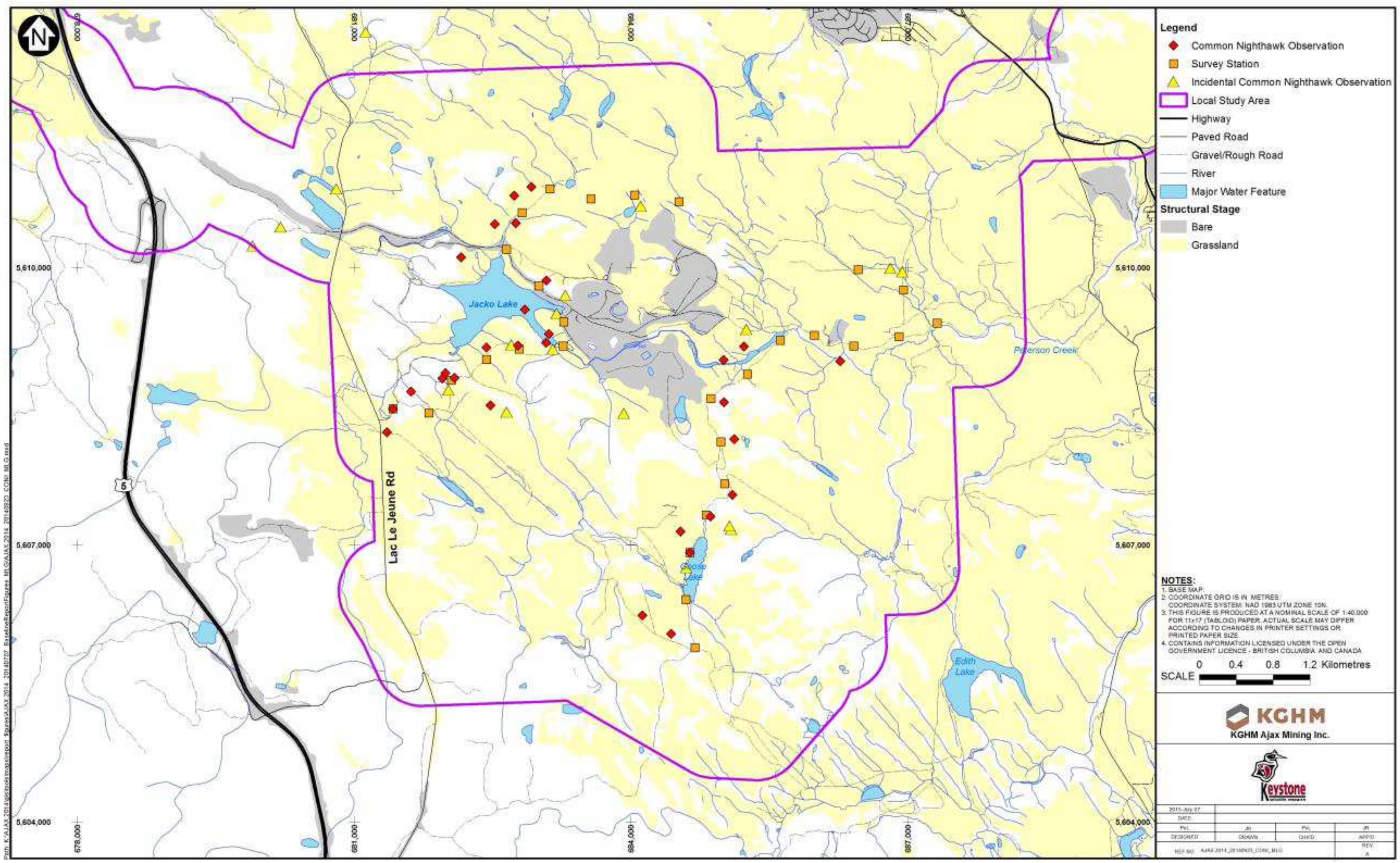
Nighthawk surveys took place on the evenings of June 25 and 26, 2014. Twenty-nine stations were completed (**Figure 11-5)**, each sampled once for a total survey time of two hours six minutes. Thirty-two Common Nighthawk detections were recorded on 20 stations, of which 13 detections were booming males (**Table 11-7**). Detections were concentrated south of Jacko Lake.

Seventeen incidental detections of Common Nighthawk were recorded in 2010, 2011 and 2014 (**Figure 11-5; Plate 11-7**), including a nest with two eggs observed on June 26, 2014, and a nest with two well-grown nestlings on August 14, 2014.

Table 11-7 Common Nighthawk Call-Playback Survey Results

Call Playback Station	Number Observed	
	Adults Unclassified Sex	Adult Males
Ajax_CP_B-CONI_2014-Jun-25_1	0	1
Ajax_CP_B-CONI_2014-Jun-25_2	1	0
Ajax_CP_B-CONI_2014-Jun-25_3	1	1
Ajax_CP_B-CONI_2014-Jun-25_4	1	0
Ajax_CP_B-CONI_2014-Jun-25_5	1	1
Ajax_CP_B-CONI_2014-Jun-25_6	0	1
Ajax_CP_B-CONI_2014-Jun-25_8	0	2
Ajax_CP_B-CONI_2014-Jun-25_9	0	1
Ajax_CP_B-CONI_2014-Jun-25_10	0	1
Ajax_CP_B-CONI_2014-Jun-26_16	0	1
Ajax_CP_B-CONI_2014-Jun-26_17	2	1
Ajax_CP_B-CONI_2014-Jun-26_18	1	1
Ajax_CP_B-CONI_2014-Jun-26_19	3	0
Ajax_CP_B-CONI_2014-Jun-26_20	1	1
Ajax_CP_B-CONI_2014-Jun-26_21	1	0
Ajax_CP_B-CONI_2014-Jun-26_22	1	0
Ajax_CP_B-CONI_2014-Jun-26_23	2	0
Ajax_CP_B-CONI_2014-Jun-26_24	3	0
Ajax_CP_B-CONI_2014-Jun-26_25	1	0
Ajax_CP_B-CONI_2014-Jun-26_26	0	1
Grand Total	19	13

Common Nighthawk Call-playback Stations and Detections



KGHM Ajax Mining Inc. - AJAX PROJECT Proj # 0230366-0005 | GIS # AJAX.2014_20140923_CONI_MLG

Figure 11-5 Common Nighthawk Call-playback Stations and Locations

Plate 11-7 Common Nighthawk at Nest (L. Andrusiak photo)

Incidental Migratory Bird Observations

Bird species detected while completing other work (e.g., map field-truthing) were recorded as incidental observations. Species recorded only as incidentals included Common Poorwill *Phalaenoptilus nuttallii*, Pygmy Nuthatch *Sitta pygmaea*, Say's Phoebe *Sayornis saya*, and Western Bluebird *Sialia mexicana*, none of which are considered species at risk. One incidental detection of the Red-listed Brewer's Sparrow *Spizella breweri breweri* was recorded.

Listed species were also detected incidentally. A Great Blue Heron was seen in the yard of a ranch near Jacko Lake in 2007, and another heron was observed landing on Peterson Creek south of the Ajax pits in 2008. Barn Swallows were seen occasionally flying near the Ajax pits, and a Barn Swallow nest with an unhatched egg was found in a crevice on a rock outcrop near the edge of the Ajax South Mined Rockpile in August 2008. A Lewis's Woodpecker was sighted flying north of the Ajax pits, and another single bird was observed south of the Afton tailings pond in June 2008. In addition, mine staff observed 2 common nighthawks in August of 2014.

Habitat Suitability Mapping

Habitat suitability mapping within the TEM portion of the LSA is summarized in **Table 11-8** below.

Table 11-8 Habitat Suitability Mapping for Lewis's Woodpecker and Williamson's Sapsucker in the TEM Portion of the LSA

Lewis's Woodpecker Reproducing Suitability	Ha in TEM portion of LSA	% of TEM portion of LSA	Williamson's Sapsucker Living Suitability Class	Ha in TEM portion of LSA	% of TEM portion of LSA
Low	4,204.0	70.7	4 (Low)	88.7	1.5
Nil	1,739.6	29.3	5 (Very Low)	763.6	12.8
TOTAL	**5,943.6**		6 (Nil)	5,091.2	85.7
			TOTAL	**5,943.6**	

Lewis's Woodpecker

Low-rated Lewis's Woodpecker nesting habitat was mapped throughout the LSA (**Figure 11-6**). The LSA was rated Low or Nil due to the generally young age of the forested habitat.

Williamson's Sapsucker

Only 89 ha of Class 4 Living habitat was mapped for Williamson's Sapsucker (**Figure 11-7**), reflecting the scarcity of mature forests with snags and or large-diameter aspens in the LSA. Class 4 habitat is located outside of the LSA on Sugarloaf Hill, north of the Ajax pits and south of the Ajax South Mined Rockpile, and along the southern border of the LSA. Field habitat suitability ratings by a biologist experienced with Williamson's Sapsucker habitat were a maximum of Low (L. Gyug, pers. comm.). There are historical records of Williamson's Sapsucker south of Jacko Lake (BC Conservation Data Centre 2007).

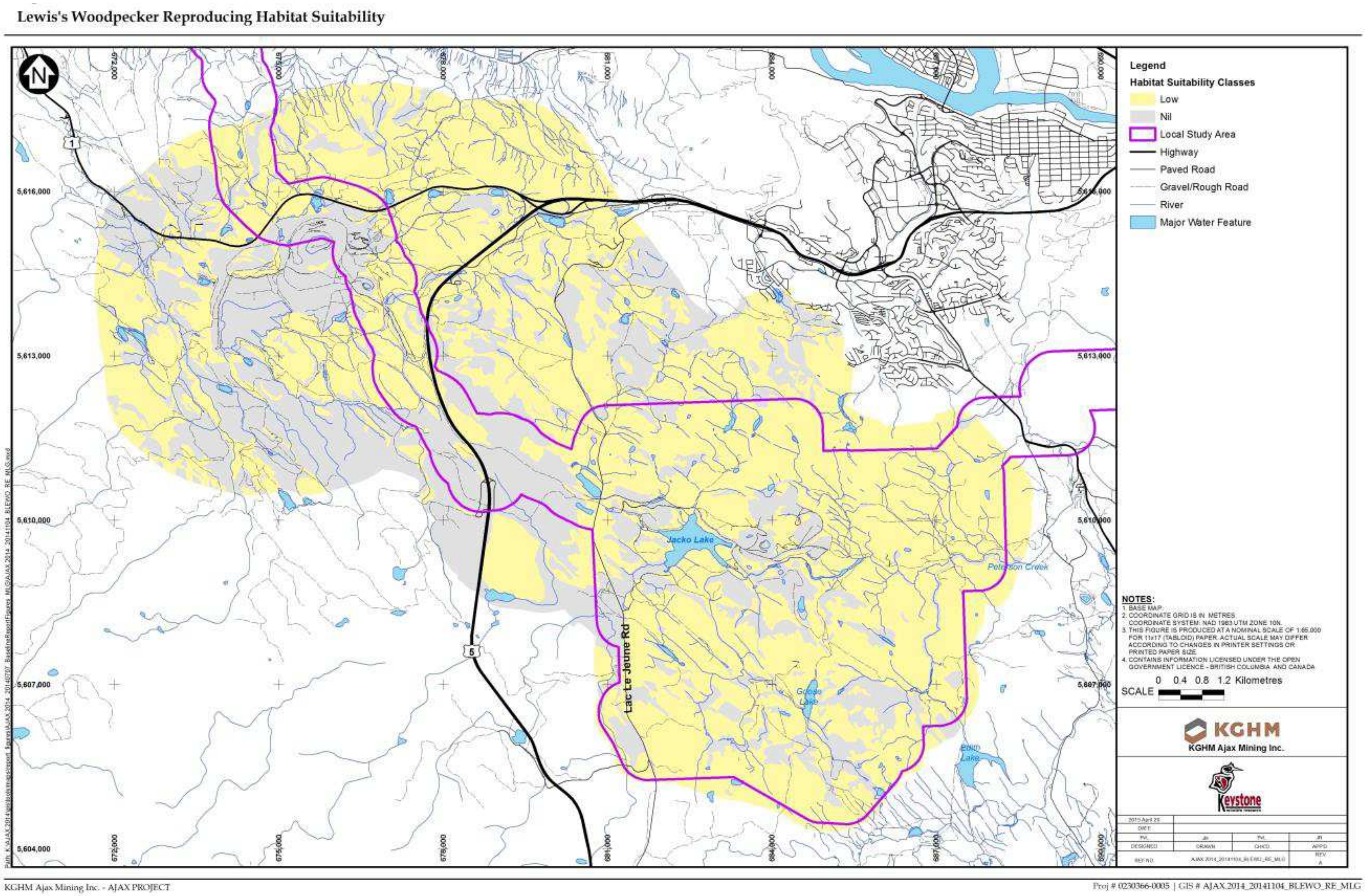


Figure 11-6 Lewis's Woodpecker Reproducing Habitat Suitability

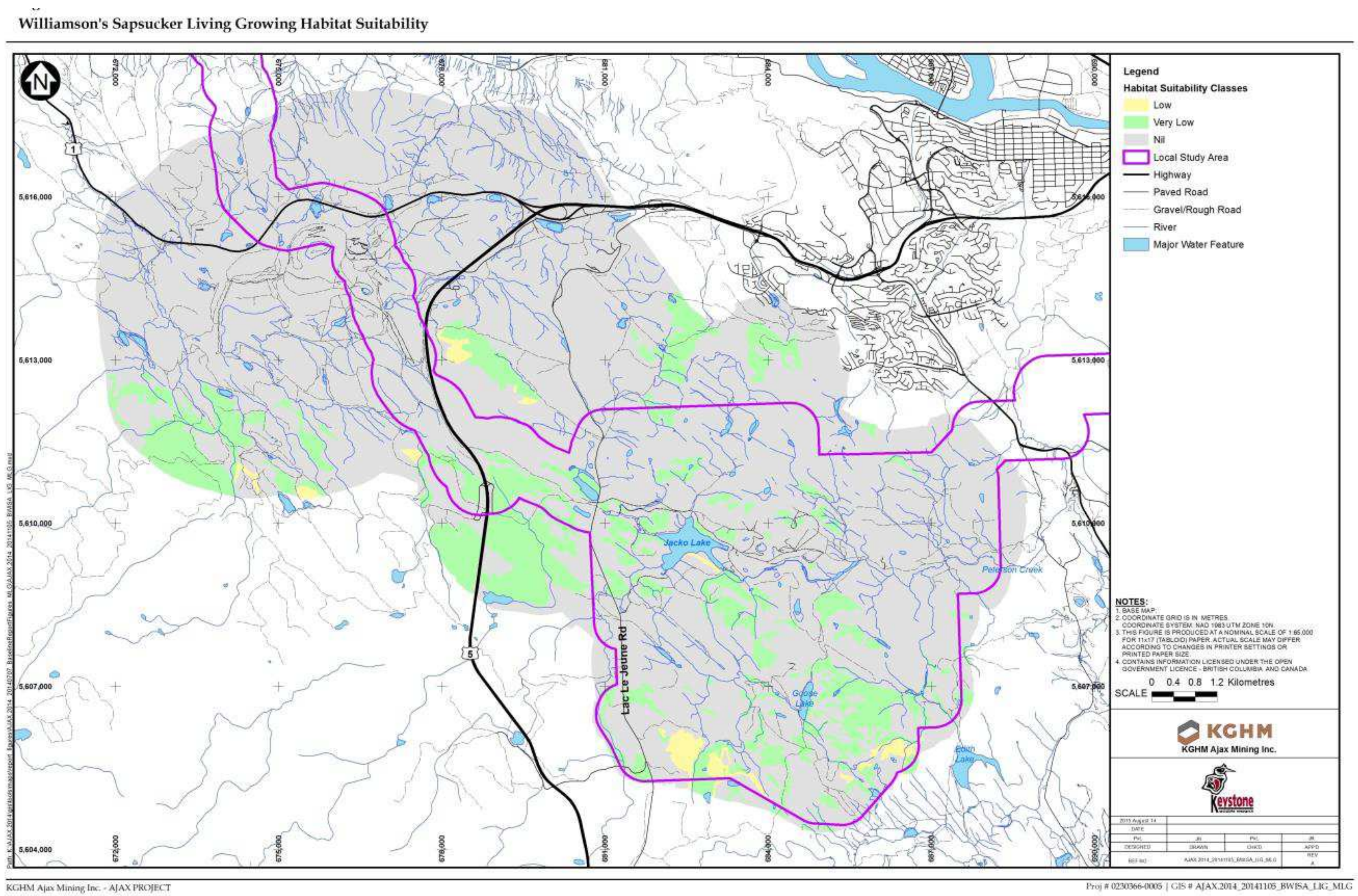


Figure 11-7 Williamson's Sapsucker Living Growing Habitat Suitability

12.0 RAPTORS

12.1 Baseline

Indicator species for the raptor VC include Bald Eagle, Burrowing Owl, Flammulated Owl, Peregrine Falcon, Prairie Falcon, Great Gray Owl, Rough-legged Hawk, Short-eared Owl and Swainson's Hawk. Brief summaries of the biology of the indicator species are provided below.

Bald Eagle

The Bald Eagle is a large, dark brown raptor. Mature birds can be identified by their white head, while the heads of juveniles and subadults are completely or partially dark, respectively. Bald Eagles feed primarily on fish, waterfowl and carrion, especially ungulates (Blood & Anweiler 1994). They build large, bulky stick nests in large trees, usually close to waterbodies where food is readily available. Eagles are territorial and will exclude other eagles or competitors such as Ospreys (*Pandion haliaetus*). Most Bald Eagles that nest in the interior winter along the coast as food is less available in the interior once most waterbodies freeze, but eagles may be seen in the vicinity of Kamloops year-round (Howie 2004). Subadults and non-breeding adults may be nomadic during both the winter and the growing season (Blood & Anweiler 1994).

A pair of Bald Eagles is resident on Jacko Lake during the growing season. Two nests are present, one on the south shore of the lake at Jacko Creek, and one on the southeast arm of the lake near the Peterson Creek outlet.

Burrowing Owl

The Burrowing Owl is a small, burrow-nesting owl that is provincially Red-listed, listed as an Endangered Species under the BC Wildlife Act, and is classified as Endangered on SARA's Schedule 1 (BC Conservation Data Centre 2014a). A provincial recovery plan has not yet been prepared for the species, though a national recovery plan has been released (Environment Canada 2012). That recovery plan has partially identified critical habitat for Burrowing Owls as the area of black-tailed prairie dog (*Cynomys ludovicianus*) colonies in Canada. The long-term goal of the recovery plan includes maintenance of at least 30 pairs of owls in the wild in BC.

The Burrowing Owl is considered a resident species in the province, although it is suspected that overwintering behaviour is a result of captive-bred individuals being released too late in the growing season to migrate (BC Ministry of Water, Land and Air Protection 2004). Migratory individuals arrive in March, with all individuals initiating breeding in late April. Nesting is typically complete by July (Leupin et al. 2000) and migrants depart BC in September (Campbell et al. 1990b), while resident individuals remain year-round.

Once considered extirpated from the province (Leupin et al. 2000), captive breeding has re-established populations in the Thompson and Nicola regions, although the owl population is not self-sustaining and is maintained by annual releases of captive-bred birds (Environment Canada 2012). Each year a number of 'wild' owls are documented returning to artificial burrow sites. Threats to the species are thought to include continued habitat loss and fragmentation, decreased prey abundance, predation, poor weather, vehicle mortalities, and contamination, although the link between habitat degradation and owl population declines is not well documented (Environment

Canada 2012). Predation (primarily by coyotes, red foxes and skunks) is the main cause of mortality of adults and juveniles in Canada (Environment Canada 2012).

The Burrowing Owl Conservation Society reported that 19 owls successfully migrated back to the BC reintroduction sites in the spring of 2011 (Meads 2011). A single introduced owl overwintered at the Beresford reintroduction site, east of the Project, in 2011/2012, and another introduced individual returned to that site (Meads 2012). Local birders have reported occasional sightings of single owls in the vicinity of the LSA, which are probably transients from a reintroduction site to the east in Knutsford.

Flammulated Owl

The Flammulated Owl is a small owl that is associated with dry forested habitats in the interior of BC. It is Blue-listed provincially, and listed on SARA's Schedule 1 as a species of Special Concern (BC Conservation Data Centre 2013b). The Flammulated Owl winters in Mexico and Central America, and arrives on its breeding range in BC in late April (Van Woudenberg & Kirk 1999). Nesting occurs from May to early August (Van Woudenberg & Kirk 1999), and males will often return to specific territories in successive years (BC Ministry of Water, Land and Air Protection 2004).

Suitable nesting stands are composed of old coniferous forests dominated by Douglas-fir and ponderosa pine, with multiple canopy layers and snags with nesting cavities. Low shrubs and forbs dominate the understory (Van Woudenberg & Kirk 1999). Flammulated Owls nest in woodpecker-excavated cavities, snags, veteran Douglas-fir or veteran ponderosa pine (McCallum 1994). Loss and degradation of suitable old-forest nesting habitat is thought to be the primary threat to the Flammulated Owl.

Flammulated Owls were detected in the Cherry Creek area south of the existing Afton tailings pond in 1995 (van Woudenberg et al. 2008) and are known to breed in the vicinity of Kamloops (Howie 2004). A species account for the Flammulated Owl is presented in **Appendix 9**.

Great Gray Owl

The Great Gray Owl is a large grey owl with a large, rounded head without visible ear tufts. Great Gray Owls may be present year-round in the Kamloops area and are known breeders (Howie 2004). Nesting occurs in coniferous or deciduous forests (Bull & Duncan 1993). Great Gray Owls are sit-and-wait predators that capture small mammals from a perch site with good visibility. They often hunt during the day and are particular adept at capturing prey beneath snow cover in the winter (Bull & Duncan 1993). Great Gray Owls are listed as Not At Risk by COSEWIC and are Yellow-listed by the province.

Prairie Falcon

The Prairie Falcon is a diurnal raptor that inhabits the dry interior of BC. It is an Identified Wildlife species and is currently Red-listed provincially, though its federal status is 'Not at Risk' (BC Conservation Data Centre 2013b). The Prairie Falcon feeds mainly on small birds and small mammals. Prairie Falcons nest on cliff faces and hunt in adjacent dry grasslands and shrublands (Cooper & Beauchesne 2004a). Availability of prey is believed to be a major factor in reproductive success. Most Prairie Falcons in BC are thought to migrate south during the winter, although a few are known to be resident (Cooper & Beauchesne 2004a).

Degradation of grassland foraging habitat due to urbanization, agriculture, and forest encroachment is believed to be the greatest threat to Prairie Falcons in BC. There is some evidence that Prairie Falcons are relatively tolerant of human activities, occasionally nesting near human dwellings and disturbance (Cooper & Beauchesne 2004a).

No current or historical nest sites are known from the LSA, although breeding is known from the vicinity of Kamloops (Howie 2004). The only potential nesting habitat in the vicinity of the Project is on the steep rock faces on the west side of Sugarloaf Hill.

Peregrine Falcon

The Peregrine Falcon is found around the world, from the Arctic to the tropics. The *anatum* subspecies is found throughout the interior of the province and is mostly migratory. *Falco peregrinus anatum* is Red-listed in BC due to low populations and declining habitat availability (BC Conservation Data Centre 2013b). It is also listed as threatened under Schedule 1 of SARA (*ibid.*), although COSEWIC groups it with the *tundrius* subspecies under the 'Special Concern' rank.

The Peregrine Falcon is known as a highly adaptable species that can use a variety of habitats depending on its location (Beebe 1974). The *anatum* subspecies generally occurs in association with wetlands, large rivers, coastal shores, lakes, or other open habitats that can support large numbers of their preferred prey, which includes seabirds, shorebirds, waterfowl and passerines (Cannings et al. 1987; Campbell et al. 1990b). Nesting occurs close to or overlooking those habitats, typically on inaccessible cliff ledges (Fraser et al. 1999). Steep cliffs provide an effective perch site from which to easily detect prey, while at the same time functioning as a nest location that is relatively secure from predators (Beebe 1974).

Peregrines appear to be limited by prey abundance and adequate nesting sites. Destruction and degradation of wetland foraging habitat is a major threat posed by human developments, thus reducing the amount of suitable habitat for prey populations (Fraser et al. 1999). The development of hillsides below nests is also a threat to nesting peregrines, as they are known to be sensitive to repeated human disturbance, potentially abandoning nest sites (Cooper & Beauchesne 2004b).

The only potential nesting habitat for peregrines in the vicinity is located on the cliffs on the west side of Sugarloaf Hill, but no current or historical nest sites have been documented there. The Peregrine Falcon may be observed all year round but is not confirmed to breed in the vicinity of Kamloops (Howie 2004). The LSA does not include habitats that support large concentrations of passerines, waterfowl or shorebirds. Only three nest sites are known in interior BC (BC Conservation Data Centre 2013b).

Rough-legged Hawk

The Rough-legged Hawk is a medium-sized, diurnal raptor that is found at northern circumpolar latitudes (Beebe 1974). It is a buteo hawk that is provincially Blue-listed and listed as Not at Risk by COSEWIC (BC Conservation Data Centre 2014d).

The Rough-legged Hawk summers in the Arctic and winters in southern Canada and south through the contiguous United States (Beebe 1974). Southern migration begins in late summer/early fall, with the return journey taking place in late winter/early spring (*ibid*.). As Rough-legged Hawks are strictly an Arctic-breeding species (Beebe 1974), they do not breed in the Kamloops area. They are generally present from October through April (Howie 2004).

The diet of Rough-legged Hawks is made up almost entirely of small mammals and small birds; they have been reported to hunt mainly at dawn and dusk (BC Conservation Data Centre 2014d). As large insects are not available in the Arctic during the summer stay, Rough-legged Hawks are not known to utilize this food source as other medium-sized buteos would (Beebe 1974), although some smaller insects may occasionally be consumed (BC Conservation Data Centre 2014d). Because of relative prey abundances, grasslands, cultivated fields and other open areas are their primary wintering habitat.

Short-eared Owl

The Short-eared Owl is a medium-sized owl that is associated with grassland habitats. It is provincially Blue-listed and listed on SARA's Schedule 3 (BC Conservation Data Centre 2013b). Short-eared Owl populations are cyclic and nomadic, and thus are difficult to monitor (BC Ministry of Water, Land and Air Protection 2004).

During the summer Short-eared Owls nest in grasslands, marshes, old fields, and open habitats, feeding on small rodents. Nests are built on the ground and eggs are laid in March to May. During the day, the owls roost on the ground or occasionally in shrubs or small trees. Most Short-eared Owls winter in the Fraser Valley, although a few remain in the interior (BC Ministry of Water, Land and Air Protection 2004). The loss of wintering habitat due to urbanization and changing agricultural practices is thought to be the greatest threat to the Short-eared Owl (BC Ministry of Water, Land and Air Protection 2004).

Swainson's Hawk

Swainson's Hawk is a buteo hawk that is provincially Red-listed (BC Conservation Data Centre 2013b). Swainson's Hawks are migratory and are listed as uncommon to fairly common migrants and summer visitants to the Thompson-Okanagan plateau in the southern interior (Cooper 1998). Preferred habitat for the species is described as 'open woodlands with mixed forests and groves adjacent to grasslands, farmlands and wetlands' (Fraser et al. 1999). Swainson's Hawks feed on insects (especially grasshoppers) as well as on small mammals and birds (Olendorff 1973). The species forages for much of its prey on the ground, but will also perch on fenceposts or trees to scan for small mammals (Beebe 1974).

The large stick nests are usually built in trees (black cottonwood and aspen), and pairs may re-use old nests in successive years (Beebe 1974; Fraser et al. 1999; Dechant et al. 2001). Most of the suitable breeding habitat for Swainson's Hawk in the province is on private land, and the species is thought to be threatened by loss of grasslands to agriculture and urbanization .

12.2 Methods

Flammulated Owl Surveys

Surveys for Flammulated Owls consisted of call-playback surveys, and were conducted according to methodology described in the RISC standard *Inventory Methods for Owl Surveys* (Hausleitner 2006). Survey transects were established to sample forested ecosystem units that corresponded to suitable habitat for Flammulated Owls and that were located along accessible survey routes (e.g. near roads). Call-playback stations were placed along transects at intervals of 500 m, as recommended by Hausleitner (2006) but spot-checks (single stations) were also used if habitat patches were not contiguous.

Call-playback was conducted by a crew of two persons, with surveys generally beginning ½ hour after sunset and finishing no later than a ½ hour before sunrise. At each station, the wind (Beaufort factor), cloud cover, temperature (degrees Celsius), and precipitation were recorded. The start and end time of each station was recorded. A GPS unit was used to record station position in NAD83 UTM co-ordinates.

At each call-playback station, pre-recorded Flammulated Owl calls were broadcast for 1 minute at 5-minute intervals, a total of three times. Thus, each call-playback station was surveyed for a minimum of 15 minutes total time.

Raptor Encounter Transects

Encounter transects for raptors were completed according to methods described in RIC (2001) for roadside surveys, which are recommended for diurnally active raptors such as Burrowing Owl and Swainson's Hawk. Transects were done from a vehicle and/or on foot. A crew of two observers watched and listened for soaring and perched raptors while walking or driving slowly. The weather conditions (cloud cover, temperature, precipitation) at the start and end of the transect were recorded, as was the total distance covered. Any raptors detected were identified to species and the age and sex determined (if possible). Locations of observations were recorded with a handheld GPS unit.

Transects were done both during the summer breeding season to target VC indicator species potentially present during the summer (Swainson's Hawk, Burrowing Owl) and during the winter to determine wintering species.

Habitat Suitability Mapping

Suitability mapping for Flammulated Owl was completed as described in Section 3.1.

12.3 Results

Flammulated Owl Surveys

Flammulated Owl surveys were completed in 2007, 2008, 2010 2011 and 2014 (**Table 12-1**). The owl survey targeted areas of potentially suitable habitat (coniferous forest) (**Figure 12-1**).

Eighty-five owl call-playback stations lasting at least 15 minutes each (21 hours 34 minutes total listening time) were completed in total. No Flammulated Owls were detected, although Great Horned Owls (**Plate 12-1**) responded to playbacks during 2014 surveys. Most of the forest within the LSA is dense and young with few snags or veteran trees, currently of low suitability as Flammulated Owl breeding habitat.

Table 12-1 Summary of Flammulated Owl Call-Playback Survey Effort

Survey Date	Transect	Total Survey Stations	Total Listening Time (hh:min)
June 6, 2007	JL	9	02:20
June 26, 2007	JL	1	00:15
June 27, 2007	JL	7	01:45
July 7, 2007	GL	8	02:00
June 11, 2008	GL08	7	01:45
June 8, 2010	F	5	01:19
June 12, 2010	G	3	00:45
July 24, 2011	TSF	8	02:10
June 27, 2014	1	3	00:45
	Spot	1	00:15
June 26, 2014	2	4	01:00
	Spot	4	01:00
Jun 25, 2014	Spot	1	00:15
July 10, 2014	2	2	00:30
	Spot	4	01:00
July 11, 2014	1	3	00:45
	2	2	00:30
	Spot	1	00:15
July 22, 2014	2	4	01:00
	Spot	2	00:30
July 23, 2014	1	3	00:45
	Spot	3	00:45
Grand Total		85	21:34

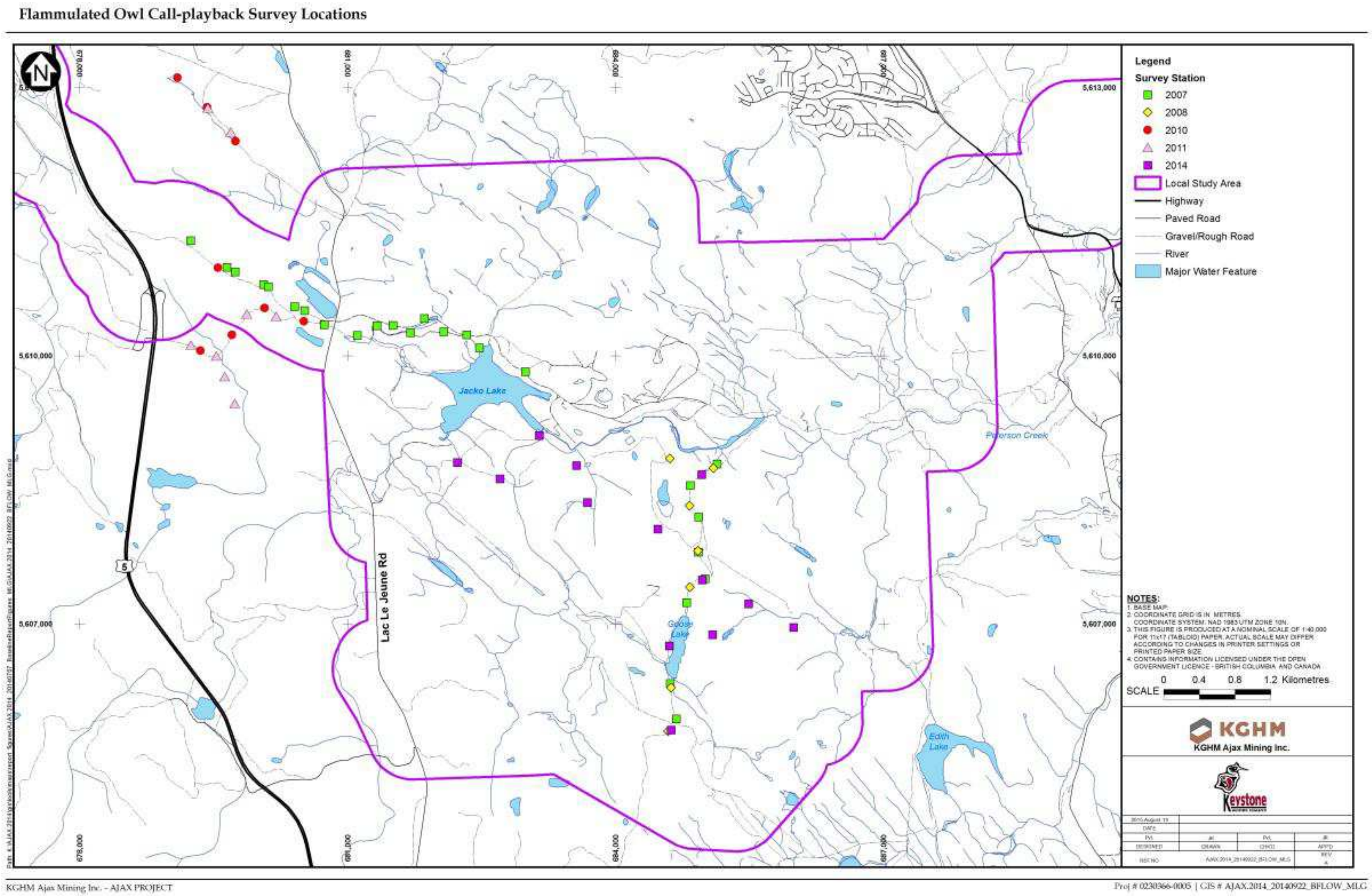


Figure 12-1 Flammulated Owl Call-playback Survey Locations

Plate 12-1 Young Great Horned Owl (L. Andrusiak photo)

Raptor Encounter Transects

Encounter transects were done in 2010, 2012 and 2014 (**Table 12-2**). In total, 156 km of transects were surveyed (**Figure 12-2**).

Table 12-2 Summary of Raptor Encounter Transect Survey Effort

Transect Name	Survey Date	Total Time (hr min)	Total Distance (km)
Raptor_Encounter_Jun_08_2010	June 8, 2010	02h10	17.3
Raptor_Encounter_Feb_08_2012-1	February 8, 2012	01h27	35.8
Raptor_Encounter_Feb_08_2012-2	February 8, 2012	00h44	2.0
Raptor_Encounter_Feb_08_2012-3	February 8, 2012	00h39	7.7
Raptor_Encounter_Mar_10_2012	March 10, 2012	04h54	44.1

Transect Name	Survey Date	Total Time (hr min)	Total Distance (km)
Raptor_Encounter1_10_Feb_19_2014	February 19, 2014	01hr12	28.5
Raptor_Encounter_Jun_10_2014	June 10, 2014	02hr17	20.6
Grand Total		13:23	156

Results of raptor encounter transects are summarized in **Table 12-3**. Seven raptor species were observed in total. Four species were detected on the summer transects (American Kestrel *Falco sparverius*, Red-tailed Hawk *Buteo jamaicensis*, Bald Eagle *Haliaeetus leucocephalus* and Turkey Vulture *Cathartes aura*). Kestrels were not detected during the winter transects, and Rough-legged Hawks (*Buteo lagopus*; Blue-listed) were present only on the winter transects. Rough-legged Hawks do not breed in BC, but winter across the southern half of the province (BC Ministry of Forests, Lands, and Natural Resources 2013). Red-tailed Hawks, Bald Eagles, Northern Harriers (*Circus cyaneus)* and Golden Eagles (*Aquila chrysaetos)* appeared to use the area in both summer and winter, and were also detected during other field surveys as incidental observations.

Table 12-3 Results of Raptor Encounter Transects

Date	Species	Total Detections
June 8, 2010	American Kestrel	6
	Red-tailed Hawk	7
June 8, 2010 Total		13
February 8, 2012	Bald Eagle	1
	Rough-legged Hawk	4
	Red-tailed Hawk	2
February 8, 2012 Total		7
March 10, 2012	Bald Eagle	2
	Golden Eagle	1
	Northern Harrier	1
	Rough-legged Hawk	4
	Red-tailed Hawk	5
March 10, 2012 Total		13
February 19, 2014	Rough-legged Hawk	2
June 10, 2014	Turkey Vulture	2
	Red-tailed Hawk	3
	American Kestrel	1
	Bald Eagle	1
June 10, 2014 Total		7
Grand Total		42

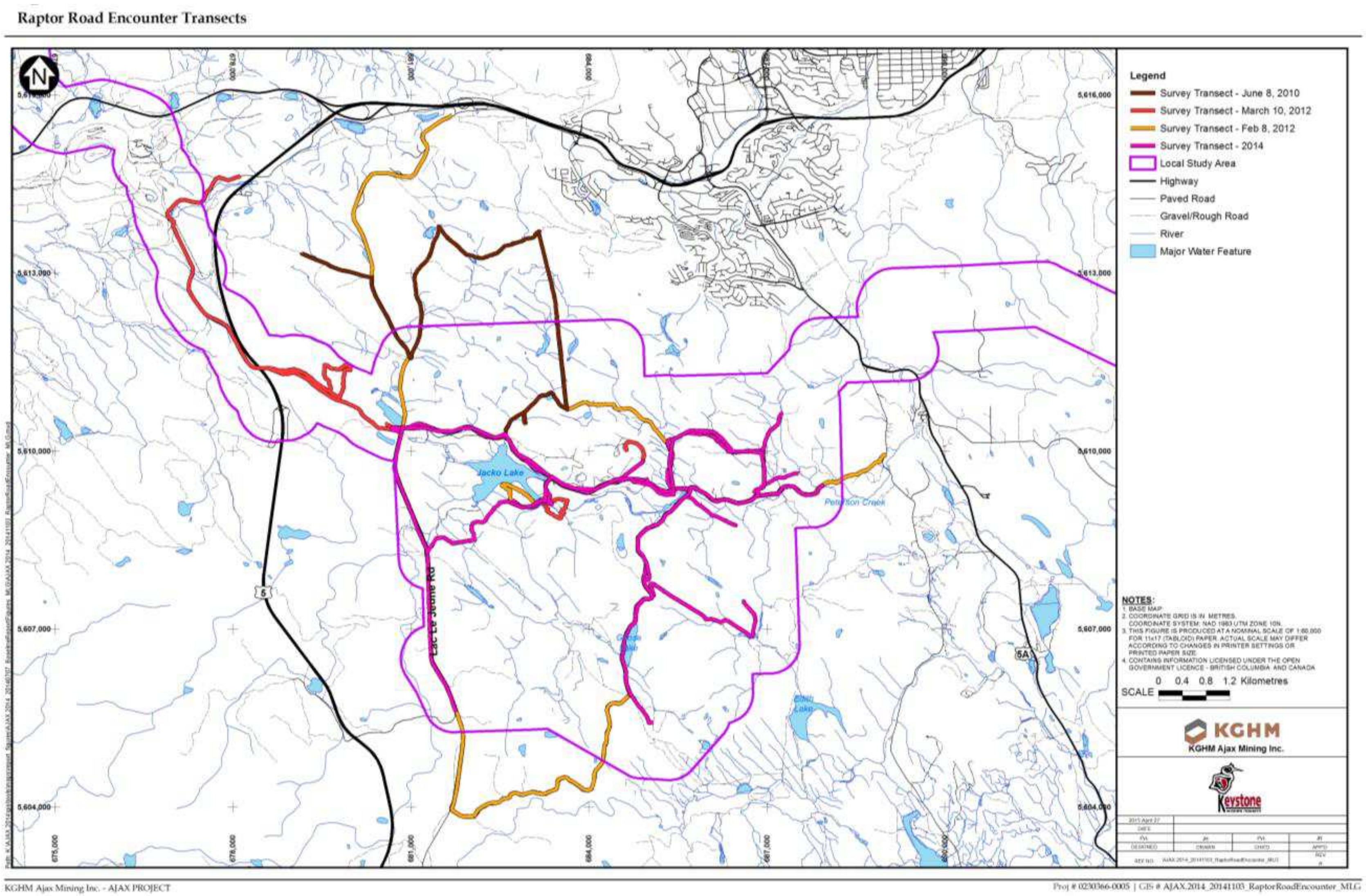


Figure 12-2 Raptor Road Encounter Transects

Incidental Raptor Observations

Several listed raptor species were observed on other surveys or incidentally. A Peregrine Falcon was observed stooping at waterfowl on Goose Lake in August 2008. A pair and a single Swainson's Hawk were observed on two occasions in 2008 and a single bird at the same location in 2011, on Lac Le Jeune Road just north of the turnoff to the Abacus camp, and a single Swainson's Hawk was sighted west of the Ajax West pit in 2008. Two additional sightings of single Swainson's Hawks were recorded during bird surveys in 2010. Two breeding pairs were observed in 2011. One nest with two adults and a single juvenile was found in the EMRSF footprint. A pair of Swainson's Hawks (**Plate 12-2**) was observed in the OP footprint during invertebrate surveys. No nest was found for that pair, but their defensive behaviour (vocalizing and repeatedly diving at surveyors) indicated that a nest and/or young were in the area.

Plate 12-2 Swainson's Hawk (L. Andrusiak photo)

Four observations of the Blue-listed Short-eared Owl were recorded on April 27, 28 and 29, 2011 during Sharp-tailed Grouse surveys. All of those observations were near or within the EWRSF footprint. Four incidental detections of Rough-legged Hawk were recorded in 2014: two were observed on February 18, while two others were observed on March 18 and 19. Three of these observations were made on Lac Le Jeune Rd., south of the west gate Project entrance site (approximately 1.4 km, 3 km, and 4 km south of gate respectively), while the fourth observation was made approximately 500 m northeast of Goose Lake on Goose Lake Road. One Rough-legged Hawk was observed flying on wildlife encounter transect 'A' on March 18, 2014. There was an unconfirmed observation of a Prairie Falcon (Red-listed). The Prairie Falcon was glimpsed by a single observer on April 1, 2014 but flew off before its identification could be verified.

Yellow-listed raptor species detected incidentally during field studies include Merlin (*Falco columbarius)*, Cooper's Hawk (*Accipiter cooperii)*, Sharp-shinned Hawk (*Accipiter striatus)*, Northern Goshawk (*Accipiter gentilis)*, Osprey (*Pandion haliaetus)*, Great Gray Owl (*Strix nebulosa)* and Long-eared Owl (*Asio otus)*. One Great Gray Owl was seen approximately 750 m southeast of Jacko Lake on February 3, 2014. One Long-eared Owl was heard on April 20, 2008 on Goose Lake Road. A list of all vertebrate species detected on field surveys is presented in **Appendix 7**.

A number of raptor nests were located during fieldwork. These included:

- Three Red-tailed Hawk nests
- A Bald Eagle nest on the south shore of Jacko Lake, and a second Bald Eagle nest on Jacko Creek near its inlet to Jacko Lake
- A Great Horned Owl nest (**Plate 12-3**) in a Douglas-fir within the EMRSF footprint
- Two Swainson's Hawk nest sites; one in the OP footprint and one in the EMRSF footprint.

Plate 12-3 Great Horned Owl on Nest (L. Andrusiak photo)

Habitat Suitability Mapping

Habitat suitability for Flammulated Owl in the TEM portion of the LSA is summarized in **Table 12-4**. A small amount (<240 ha) of moderate-suitability nesting habitat was mapped. Moderate-rated habitat was concentrated in the mature forest on Sugarloaf Hill outside the LSA (**Figure 12-3**), and along the southern border of the LSA. There is little contiguous suitable habitat and most consists of small, widely separated patches.

Table 12-4 Flammulated Owl Reproducing Habitat Suitability in the TEM Portion of the LSA

Reproducing Habitat Suitability	Ha in TEM portion of LSA	% of TEM portion of LSA
Moderate	239.3	4.0
Low	529.5	8.9
Nil	5,174.8	87.1
TOTAL	**5943.6**	

The relatively low amount of suitable nesting habitat reflects the general scarcity of mature and old forests in the LSA. Flammulated Owls often nest in ponderosa pine snags, but snags killed by pine beetle often fall prematurely (Gayton 2008), and the long-term effect of the current beetle epidemic on ponderosa pine-using wildlife species in the LSA is uncertain. The majority of large ponderosa pine trees have been killed. Given a projected fall rate of 3-5% per year (Schmid et al. 1985), the supply of large pine snags is expected to continue to decline until larger trees are once again available to be recruited as snags.

Flammulated Owl Reproducing Habitat Suitability

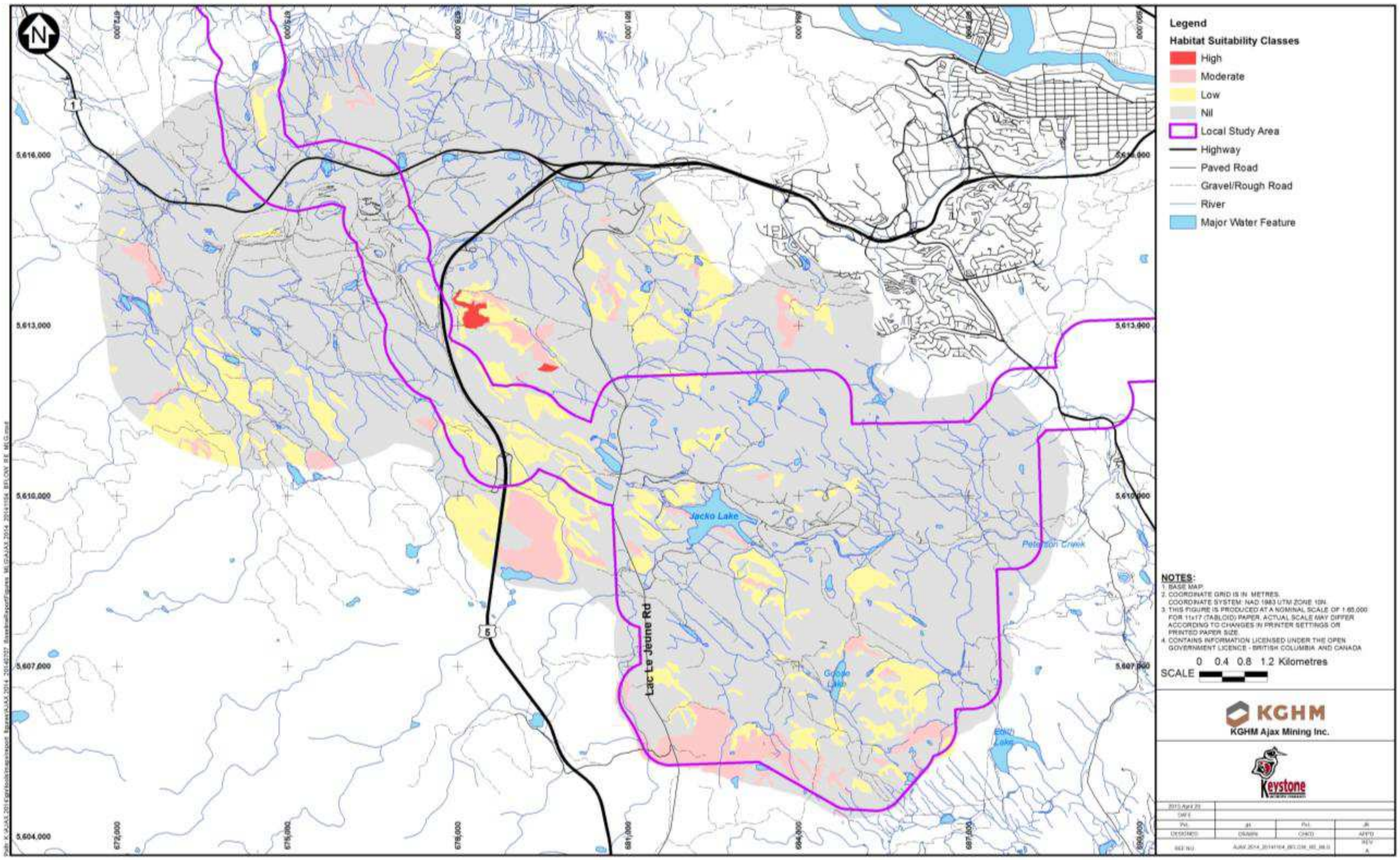


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Figure 12-3 Flammulated Owl Reproducing Habitat Suitability

13.0 GAME BIRDS

13.1 Baseline

The indicator species used for the game birds VC are Columbian Sharp-tailed Grouse and Ruffed Grouse. A brief summary of the species' biology is presented below.

Sharp-tailed Grouse

The Columbian Sharp-tailed Grouse is a bird of open grassland and sage habitats. It is provincially Blue-listed (BC Conservation Data Centre 2014a). The subspecies ranges from Vanderhoof south to Merritt and west to the Coast Mountains (BC Ministry of Water, Land and Air Protection 2004). Grouse are a traditional food source for Aboriginal peoples (University of Northern British Columbia, et al. 2011).

Sharp-tailed Grouse feed on insects, leaves, twigs, buds, catkins, fruits and berries (BC Ministry of Water, Land and Air Protection 2004). The species is considered a resident, as it does not migrate. During the breeding season, males gather at traditionally-used lekking areas in open but secluded grassy habitats to display to females. Leks are traditional and may be used for many years (BC Ministry of Water, Land and Air Protection 2004). Hens lay their eggs in tall grass or shrubby cover. Habitats with security cover and abundant insect prey are critical for successful rearing of chicks. High-quality wintering habitat includes shrubby riparian areas where berries and catkins are available, as well as dense thickets of shrubs such as rose and water birch for roosting (BC Ministry of Water, Land and Air Protection 2004).

Columbian Sharp-tailed Grouse are thought to be threatened by agricultural and residential development of native grasslands, disturbance of traditional lekking grounds, and overgrazing by livestock, which removes the tall grass cover needed as security habitat. Four active leks and two currently inactive leks are known within the LSA (S. Jones, BCMWLAP, pers. comm. 2014). A species account for Sharp-tailed Grouse is presented in **Appendix 9**.

Ruffed Grouse

The Ruffed Grouse is a forest-dwelling game bird that is provincially Yellow-listed. It is prized by hunters and a traditional food source for Aboriginal peoples (University of Northern British Columbia, et al. 2011). Ruffed Grouse prefer forests with a deciduous component. Males choose a particular drumming log to 'drum' with their wings in early spring to attract nearby females. Females nest on the ground and the chicks leave the nest to follow their mother within a day of hatching. Ruffed Grouse eat a variety of seeds, fruits, buds, and invertebrates (Campbell et al. 1990b). They do not migrate, but remain on the same home ranges year-round.

13.2 Methods

Lek Surveys

Ministry of Environment staff provided locations of known Sharp-tailed Grouse lek sites in the LSA. Field surveys to confirm use at known lek sites, and to identify any additional lek sites, were conducted following methods described in RIC (1997) at the present/not detected survey level.

Survey stations were placed 800 m apart and were surveyed between 30 minutes before sunrise to two hours after sunrise, although one reconnaissance visit was done during one afternoon in 2011. All visual and auditory detections of Sharp-tailed Grouse were recorded.

Habitat Suitability Mapping

Habitat suitability mapping was prepared for Columbian Sharp-tailed Grouse for the life requisite 'Living" during the winter and growing seasons as described in Section 3.1. "Living" is satisfied by the presence of suitable feeding, and security/reproductive habitat as described in detail in **Appendix 9**.

13.3 Results

Lek Surveys

Field surveys for Sharp-tailed Grouse took place across grassland habitats during the spring (**Table 13-1**) over three mornings in April 2010 (**Plate 13-1**), two mornings in April 2011 and three mornings in March and April in 2014. Lek locations are confidential and are not shown on report figures. Twenty-seven birds were recorded in 2010, 16 birds were observed in 2011, and 19 in 2014. The maximum number of birds detected at a single site was 8 in 2010, 10 in 2011 and 7 in 2014.

The BC Ministry of Environment conducted surveys in late April 2012 at three known active leks within the LSA. Twenty-two birds in total were observed (P. Belliveau, pers. comm. 2012).

Table 13-1 Summary of Sharp-tailed Grouse Survey Effort

Visit Date	Number of Stations	Total listening time (minutes)
April 13, 2010	13	51
April 14, 2010	10	30
April 15, 2010	6	18
April 27, 2011	5	15
April 29, 2011	2	6
March 31, 2014	3	9
April 1, 2014	2	28
April 2, 2014	4	24
total	45	181

Plate 13-1 Sharp-tailed Grouse on Lek at Dawn (C. Albrecht photo)

Incidental Grouse Observations

Sharp-tailed Grouse were observed incidentally near lek sites during surveys for other wildlife in spring. Seven detections that totalled 16 birds were recorded.

Seventeen detections of Ruffed Grouse were made during breeding bird point counts (see Section 10). Ruffed Grouse were also observed incidentally in 2014 along Goose Lake Road and south of the haul road northwest of Jacko Lake.

Habitat Suitability Mapping

Habitat suitability for Sharp-tailed Grouse in the TEM portion of the LSA is summarized in **Table 13-2**. Nearly 3,580 ha of high and moderate-suitability growing season habitat for Sharp-tailed Grouse was mapped within the LSA. Most of the high-rated habitat in the LSA is concentrated in the grasslands north and east of the Ajax pits (**Figure 13-1**).

Table 13-2 Sharp-tailed Grouse Growing Season and Winter Living Habitat Suitability Within the TEM Portion of the LSA

Suitability	Growing Season		Winter	
	Ha in TEM portion of LSA	% of TEM portion of LSA	Ha in TEM portion of LSA	% of TEM portion of LSA
High	2,663.8	44.8	160.9	2.7
Moderate	914.2	15.4	1,099.2	18.5
Low	696.8	11.7	1,311.9	22.1
Nil	1,668.8	28.1	3,371.5	56.7
TOTAL	**5,943.6**		**5,943.6**	

Sharp-tailed Grouse may use grasslands throughout the LSA, however, the actual suitability of grassland habitat is greatly dependent on the height of the grass, which provides security cover for adults, nests and young (D. Jury, BC Ministry of Environment, pers. comm.). Grass height is dependent on grazing pressure, and is expected to vary within and between years and is not a characteristic that is available from the ecosystem mapping. The amount of suitable growing-season habitat reported here should be considered an ideal maximum, as grazing has likely resulted in lower actual suitability across much of the LSA.

Considerably less high and moderate-suitability wintering habitat was mapped (**Table 13-2)**. Small areas of high- to moderate-suitability habitat are dispersed along waterbodies (**Figure 13-2**). The shrubby riparian habitats preferred by grouse during the winter are relatively rare in the LSA.

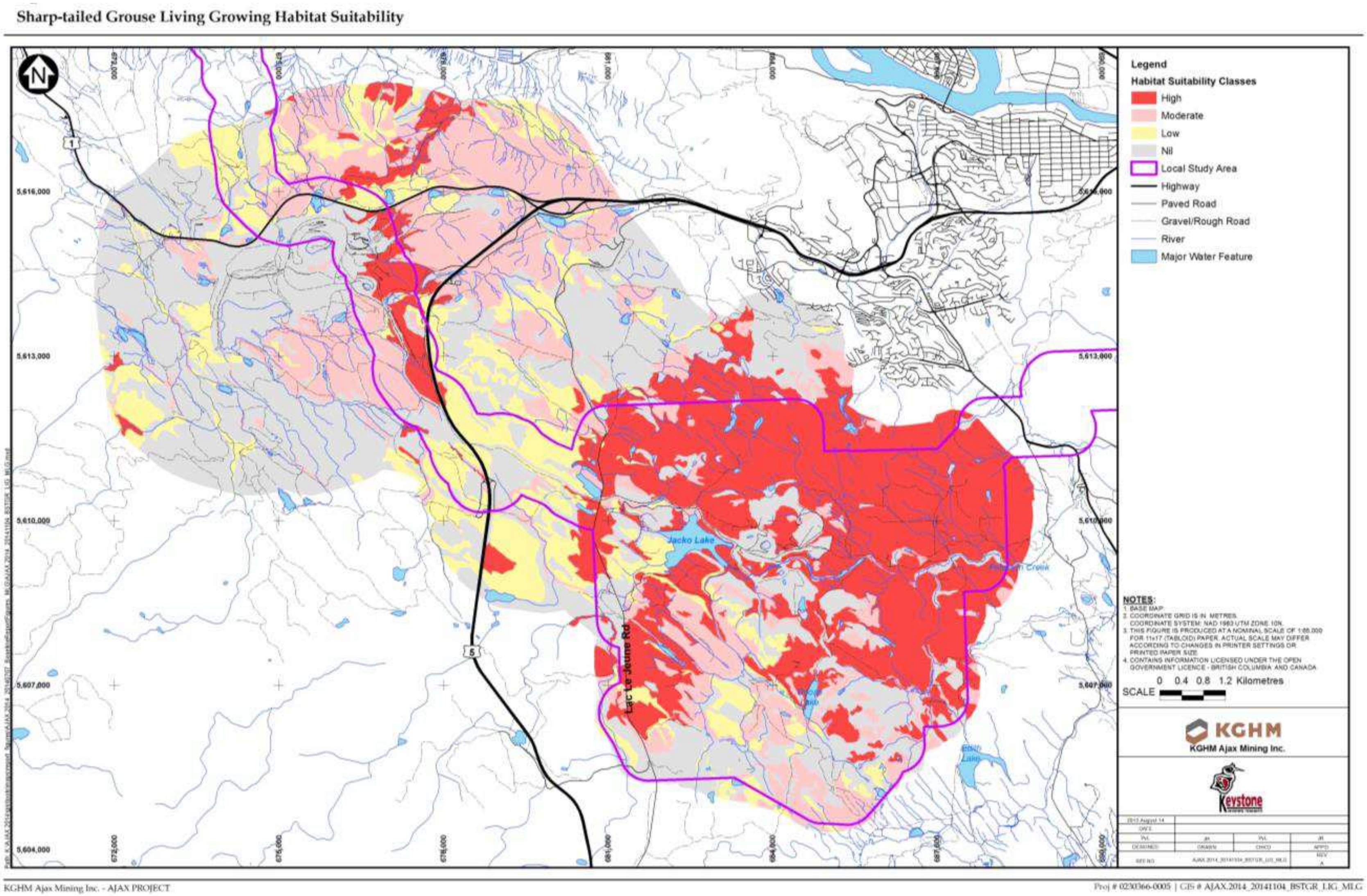

Figure 13-1 Sharp-tailed Grouse Living Growing Habitat Suitability

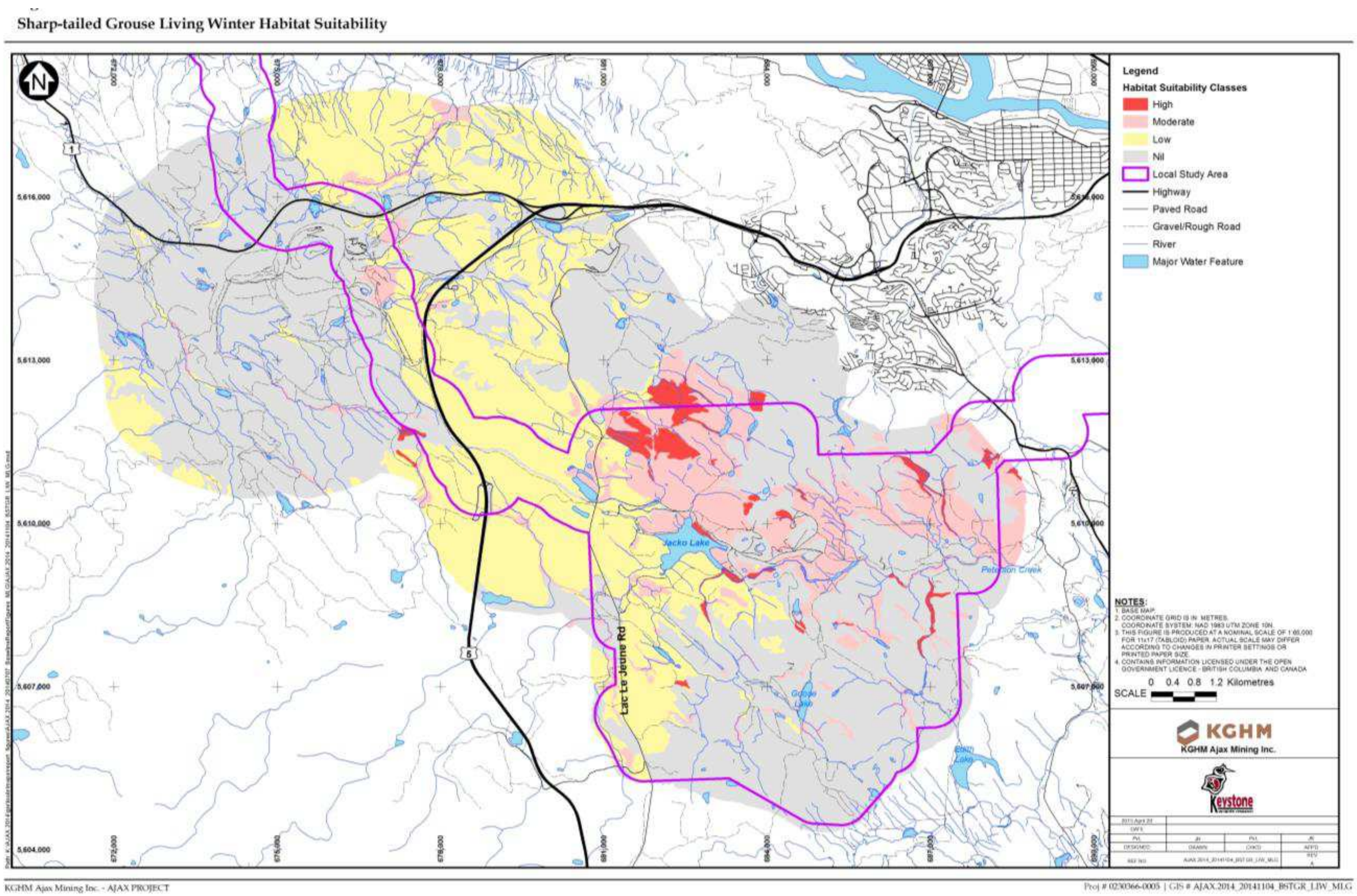

Figure 13-2 Sharp-tailed Grouse Living Winter Habitat Suitability

14.0 MAMMALS

14.1 Baseline

Indicators for the mammal VC include Great Basin pocket mouse, badger, mule deer, moose, fringed myotis, spotted bat, western small-footed myotis, and Townsend's big-eared bat. Brief summaries of the biology of the indicators are presented below.

Great Basin Pocket Mouse

The Great Basin pocket mouse is a small rodent that is provincially Red-listed. The species occupies sagebrush or antelope brush grassland habitats in the BG and IDF BGC zones, where it forages for seeds, buds and vegetation (Cannings et al. 1999). Cheatgrass (*Bromus tectorum*), sage (*Artemisia*), and Indian ricegrass (*Oryzopsis hymenoides*) are particularly important forage species (Howard 1996). The Great Basin pocket mouse is nocturnal and remains in a burrow at the base of a shrub during the day. Females give birth to one or two litters a year, and may breed throughout the autumn if vegetative food supplies are abundant (Howard 1996).

Disturbance that increases herbaceous cover tends to increase habitat value for pocket mice, which converge on recent burns (Howard 1996). Although light to moderate grazing, timber harvest, and fire have not been shown to decrease Great Basin pocket mouse populations (Howard 1996), the BC population is threatened by conversion of native grasslands to agricultural fields and urban development. A species account for Great Basin pocket mouse is presented in **Appendix 9**.

Badger

The badger (**Plate 14-1**) is a large mustelid (i.e., a member of the weasel family), found mainly in the grassland and dry open forest areas of BC. It is Red-listed provincially, and is listed as Endangered on Schedule 1 of SARA (BC Conservation Data Centre 2013b). Badgers in western North America are closely associated with open, dry grasslands with deep, friable soils that are suitable for excavating burrows (Rahme et al. 1995). They also use open, dry forests, such as those composed of ponderosa pine and Douglas-fir mixed with ponderosa pine (Stevens & Lofts 1988). Although badgers do not appear to require these grasslands or open pine forests, they likely prefer them and may attain higher densities in these open habitats (Rahme et al. 1995). Most badger activity occurs at low elevations, in valley bottoms, within dry regions of the province (BC Ministry of Water, Land and Air Protection 2004).

Plate 14-1 Badger (L. Andrusiak photo)

Burrows play a central role in the ecology of badgers, and are used for daytime resting, food storage, escape cover from predation, birth sites, and headquarters for hunting forays (Long 1973; Newhouse & Davis 2002). Adult badgers normally occupy the same home range for their whole lives (Rahme et al. 1995), and they are known to reuse the same burrows often; sometimes more often than they dig new ones (Lindzey 1982; Newhouse & Kinley 2000).

Badgers consume a variety of mammals, birds, eggs, amphibians, reptiles, carrion and vegetation, although their main diet is composed of fossorial rodents such as ground squirrels and marmots (Rahme et al. 1995; Weir et al. 2003; BC Ministry of Water, Land and Air Protection 2004). Prey abundance is an important factor for badger habitat selection, and many of their prey items tend to have highest densities in open areas (Lampe 1982; Rahme et al. 1995).

A review of badger abundance in BC in 1990 concluded that only 300 to 1,000 animals likely occurred in the province (Rahme et al. 1995). Recent estimates of badger numbers in BC are between 228 and 340 individuals, approximately 70% of which are breeding adults (*jeffersonii* Badger Recovery Team 2005). This species can be relatively tolerant of human activities, and may readily use roadsides and areas close to human developments or agricultural activities (Rahme et al. 1995; BC Ministry of Water, Land and Air Protection 2004). However, roadsides present a high risk for mortality (BC Ministry of Water, Land and Air Protection 2004). In addition to road kills, habitat destruction, degradation and fragmentation, and rodent control programs also present major threats to badger populations (Rahme et al. 1995).

Signs of badger use (burrows) were noted during field surveys in 2007, 2008, 2010, 2011 and 2014, and at least one radiocollared badger was known to use the vicinity of the Project during a previous research project (Hoodicoff 2003). Old or "legacy" burrows may be important for recolonization of areas in which badgers have been locally extirpated (R. Weir, pers. comm.). A badger species account is presented in **Appendix 9**.

Mule Deer and Moose

Mule deer and white-tailed deer (*Odocoileus virginianus*) are found in a variety of habitats within the LSA, including forest, shrublands, riparian areas and the grassland-forest interface. Moose also use the forested portions of the LSA. All three species are Yellow-listed (not at risk) provincially, and are important to Aboriginal Groups as well as being species of public concern. Moose and deer are traditional food sources for Aboriginal peoples (University of Northern British Columbia, et al. 2011).

Mule deer are the most widely distributed cervids (i.e., members of the deer family) within BC (Bunnell 1990; Blood 2000a). The mule deer is an adaptable species that inhabits a broad range of habitats (Shackleton 1999). Within any given area, mule deer use a patchwork of different habitats to meet their needs for food, security, thermal cover and snow interception cover (*ibid*.). Mule deer select old-growth Douglas-fir forests in the winter and then migrate to open grasslands as they green-up in the spring, using a variety of habitats during other parts of the year (Bonar 1987). Consumption of Douglas-fir was highest in December and January while grass comprised almost 100% of mule deer diets in spring Willms et al. (1976).

Snow depth is considered a major influence on mule deer winter distribution and abundance in the winter (D'Eon 2004). Mule deer prefer areas where snow depths are less than 30 cm, and are generally excluded from areas where snow depths exceed 50 cm (Telfer & Kelsall 1979) due to the high energetic requirements of moving through deep snow (Bunnell 1990). High-quality mule deer winter range typically consists of south-facing, gentle to moderate slopes with mature or old-growth coniferous forests, which provide snow-interception cover as well as higher abundances of shrubs and arboreal lichens than younger forests (Armleder et al. 1986; Shackleton 1999). Critical deer winter range has been mapped in the LSA in the vicinity of Sugarloaf Hill.

Moose occur throughout the majority of BC, with the exception of Vancouver Island, the Queen Charlotte Islands and the southern coastal areas (Blood 2000b). Moose use a variety of habitats including forest, openings, swamps, lakes and wetlands (BC Conservation Data Centre 2013b). Moose are generally browsers, although they will also graze and forage on aquatic plants during the summer (Franzmann 1978). Leaves and other non-woody vegetation are preferred due to the higher quality and increased digestibility of these food sources, however winter often restricts forage choices to low-quality, difficult-to-digest, woody browse (Renecker & Hudson 1986).

Winter habitat availability is generally considered the limiting factor for moose populations (Kelsall & Prescott 1971; McNicol & Gilbert 1980; Thompson & Vukelich 1981; Risenhoover 1985; Hatler 1988). Winter habitats tend to be low-elevation, riparian communities with abundant early-seral riparian vegetation (Kelsall & Telfer 1974; LeResche et al. 1974; Doerr 1983; Risenhoover 1985; Van Drimmelen 1987; Thompson et al. 1989; Modaferri 1992). Van Dyke (1995) described high-value winter feeding habitat as having greater than 30% shrub cover, low density of mature trees, and gentle slopes.

Bats

<u>Fringed Myotis</u>

The fringed myotis is an insectivorous bat that inhabits south-central BC. It is provincially Blue-listed (BC Conservation Data Centre 2014a). Few data are available on specific habitat requirements for fringed myotis. Maternal colonies have been located in agricultural areas, and bats have been captured near watercourses and in open grassland habitats (BC Ministry of Water, Land and Air Protection 2004). Roost and maternity sites have been found in rock crevices, caves, buildings, and mine shafts as well as under loose bark of ponderosa pine snags (BC Ministry of Water, Land and Air Protection 2004). Foraging habitat probably includes arid grasslands and dry ponderosa pine and Douglas-fir forests (Rasheed et al. 1995).

Potential fringed myotis roosting and hibernating habitat is present on Sugarloaf Hill and at the rock outcrop at the edge of the Ajax South Mined Rockpile (M. Sarell, pers. comm.). Potential roosting habitat is also present wherever ponderosa pine snags or rock outcrops occur. One *Myotis* bat was encountered roosting under a rock on a talus slope on the north side of Jacko Lake during snake surveys, but the bat escaped before its species could be confirmed.

<u>Spotted Bat</u>

The spotted bat is an insectivorous bat that is provincially Blue-listed, and is listed on SARA's Schedule 1 as a species of Special Concern (BC Conservation Data Centre 2014a). In BC, spotted bats have been found in grasslands, shrub-steppe and open Douglas-fir and ponderosa pine forests (COSEWIC 2004b). The species is distributed across the southern interior from Williams Lake south (BC Ministry of Environment 2008a), but there are no records from the vicinity of the Project (BC Conservation Data Centre 2007).

Steep cliff habitats are used for day and maternal roosts. Spotted bats roost and rear their young alone and do not form colonies (BC Ministry of Water, Land and Air Protection 2004). Foraging habitats include open forests, marshes, meadows, riparian areas and cultivated fields, where moths are the primary prey. Foraging habitat is generally within 10 km of roosting habitat (BC Ministry of Water, Land and Air Protection 2004). Wintering behaviour and habitat are unknown in BC.

Urbanization, disturbance at cliff roosts from rock climbing and roads, and habitat loss from hydroelectric development have been listed as potential threats to the species (BC Ministry of Water, Land and Air Protection 2004). Potential roosting habitat is present at the cliffs on Sugarloaf Hill (M. Sarell, pers. comm.).

<u>Western Small-footed Myotis</u>

The western small-footed myotis is a small bat species that is provincially Blue-listed (BC Conservation Data Centre 2014a). The western small-footed myotis is found in the southern interior of BC south of Williams Lake, but there are no records for the vicinity of the Project (BC Conservation Data Centre 2007; BC Ministry of Environment 2008b). Females give birth from mid-June to late July (Garcia et al. 1995). Maternity roost sites are not well known in BC, but are believed to include rock crevices, vertical banks, talus and rocky outcrops (Nagorsen & Brigham 1993). Those same habitats, as well as loose bark on large-diameter trees, are also thought to be used as day roosts.

This species has been documented hibernating in the province in caves and mine shafts (Nagorsen & Brigham 1993). Foraging habitat has been variously reported as arid grassland, old and mature forest, riparian areas, and rocky outcrops (Nagorsen & Brigham 1993). There is little information on critical habitat requirements or distribution for this species, but it is believed to occupy dry valley bottoms, including the Similkameen, Fraser and Thompson valleys up to 850 m in elevation (Nagorsen & Brigham 1993), in the BG, PP and IDF (Cannings et al. 1999). Determination of threats to the species is difficult due to the general lack of knowledge regarding its biology, but habitat loss due to urbanization and agriculture, and disturbance at roosts and hibernacula, are listed as potential threats (Cannings et al. 1999).

Suitable roosting and hibernating habitat is present at the cliffs on Sugarloaf Hill, at the rock outcrop at the edge of the Ajax South Rockpile, and within the old adit in the east wall of the Ajax East pit (M. Sarell, pers. comm.).

<u>Townsend's Big-eared Bat</u>

Townsend’s big-eared bat is found on Vancouver Island, on the Gulf Islands, and on the provincial mainland from Vancouver, east to Creston and north to Williams Lake (Nagorsen & Brigham 1993; Firman 2000; BC Ministry of Environment 2008c). Most records occur at low elevations (*ibid*.), and the species’ distribution at the local level is correlated with the availability of caves or cave-like roosts (Cannings et al. 1999). The species is Blue-listed in the province (BC Conservation Data Centre 2014a).

Townsend’s big-eared bat is known to use a wide variety of habitats, from coastal forests to arid interior grasslands, the species is more limited by the availability of suitable roost and hibernation sites than any other habitat feature (Nagorsen & Brigham 1993). In the US, it forages in a mosaic of forest canopies, riparian areas and along the edges of grasslands, but rarely uses early seral stages (Gruver & Keinath 2006). Summer roosting occurs in caves, old mines and buildings (Maser et al. 1981; Nagorsen & Brigham 1993). Males roost independently during the summer, but females form nursery colonies with other females and juveniles in order to assist juvenile development by maintaining higher body temperatures (Nagorsen & Brigham 1993).

Mating typically occurs during the winter (November to February) while at the winter roost, with the birth of young delayed until July (Nagorsen & Brigham 1993). Young develop quickly, and by four weeks are flying and are nearly adult size (*ibid*.). Nursery colonies disperse at the end of the summer, at which time individuals migrate a short distance (10 km to 65 km) to alternate caves and old mines, which will act as hibernacula for the winter months (*ibid*.). During hibernation, Townsend’s big-eared bats enter a state of torpor, where their metabolic activity decreases (*ibid*.). During this period, they are known to tolerate periods of sub-zero temperature, but can be roused by increasing temperatures (e.g., the arrival of spring) and by disturbance (*ibid*.).

Townsend’s big-eared bat feeds on a variety of insect prey. Although food habits are relatively unknown in BC, western U.S. populations have been observed to feed primarily on small moths, with other insects supplementing this diet (Nagorsen & Brigham 1993).

Townsend's big-eared bat is very sensitive to human disturbance. Summer roosting colonies are often used over multiple years, and females have been known to permanently abandon these "traditional" summer roosts when disturbed (Nagorsen & Brigham 1993). Disturbance of summer roosts can also decrease reproductive success (*ibid*.). When aroused by disturbances at winter hibernacula, bats may move to another area of the hibernaculum or leave to find a new (undisturbed) hibernaculum, which can be extremely draining on the stored energy reserves of a bat. Consequently, repeated disturbance of this species can lead to increased winter mortality (*ibid*.).

Potentially suitable roosting and hibernating habitat is present at the rock outcrop at the eastern edge of the Ajax South Mined Rockpile, and within an old adit in the east wall of the Ajax East pit (M. Sarell, pers. comm.), although no signs of current bat use were detected within the adit in 2008.

14.2 Methods

Small Mammal Live-trapping

Small mammal trapping was conducted for the Great Basin pocket mouse. This species occupies dry grassland-sage habitats in the BG, PP and IDF. The RSA overlaps with the theoretical range of the Great Basin pocket mouse, but no surveys have been done to attempt to establish whether the species is present.

Sampling for Great Basin pocket mouse was consistent with RIC (1998d) standards for sampling small mammals at the present-not detected level. Surveys were conducted under provincial Wildlife Act permit KA08-44016. Six straight-line transects of 20 stations each were laid out in apparently suitable habitat (dry grassland with fine-textured soils and big sage (*Artemisia tridentata*). Transect locations included the south end of the tailings pond, the grassland east of the processing plant, the grassland near Pothook Lake, and grassland/rock outcrop complex near the inactive Crescent open pit mine.

Each trap station consisted of two live-traps, one Sherman and one Longworth, placed within 2 m of the station centre point. Trap stations were 15 m apart. Traps were baited with a mixture of rolled oats and peanut butter, supplied with carrot slices for moisture, and cotton for bedding. Pocket mice are nocturnal, so traps were locked open during the day and re-baited and set in the early evening. Each transect was trapped for two nights, with traps checked each morning.

Traps without captures were locked open for the day, and captured mammals in closed traps were processed. Captures were visually identified to species. UTM locations of captures were also recorded on standard data sheets. All captured animals were released at the site of capture as soon as they were processed. Traps were then re-baited and locked open for the day.

Badger Den Investigation and Hair-snagging

Signs of digging by badgers were noted wherever they were encountered during the course of other field surveys. A number of these previously-identified sites were visited by an experienced badger biologist, who evaluated the diggings and estimated their age by the size and shape of the burrow, the amount of vegetation on the entrance and the pile of excavated material, and any tracks, claw marks or hair evident in and around the burrow.

Hair-snagging at badger digs began in the summer of 2014 in order to collect data on the numbers and sexes of badgers using the LSA. Hair-snagging methodology was based on that described in RIC (Resources Information Standards Committee 2007). Hair-snaggers were constructed from spiked galvanized mending plates, with the spikes slightly bent downwards to minimize the chance of injury from the points. The snaggers were mounted on bands of metal pipe strapping and a 3-4 cm long section of the ‘hook’ side of hook-and-loop fastening tape was attached to the strapping band on each side of the mending plate. The snaggers were installed just inside badger dens using long nails to fasten them to the side of the entrance (**Plate 14-2, Plate 14-3**).

Plate 14-2 Hair Snagger (arrow) in Badger Dig (L. Andrusiak photo)

Plate 14-3 Installing Badger Hair-snagger (L. Andrusiak photo)

Ungulate Data Review

Ungulate winter ranges delineated by the Kamloops LRMP, and draft mule deer winter range planning cells were obtained from the Province and spatially overlain with the LSA. The amount of overlap of each type of winter range was calculated. Summary reports from BC Ministry of Transportation and Infrastructure's Wildlife Accident Reporting System were reviewed in search of data on ungulate roadkills on the highways near the LSA.

Habitat Suitability Mapping

Habitat suitability mapping was completed for badger and for Great Basin pocket mouse as described in Section 3.1. Habitat suitability for Great Basin pocket mouse was modeled for Living Habitat (LI), which includes habitats used for Feeding (FD), Security/Thermal (ST), Hibernating, and Reproducing (RB). The species lives in the same habitat year-round, usually in very small areas, therefore only Living habitat needed to be modeled, since all the requisites must be met in the same location. Badger habitat suitability was rated for Living in All Seasons (see **Appendix 9** for the pocket mouse and badger species accounts).

Winter Encounter Transects

Encounter transects for wildlife were completed based on methods described by Hatler (1991) and Rudran et al. (1996) for pre-selected, line (transect) survey work. These surveys were intended to document winter use by wildlife by recording any mammal or bird observations and sign. Each winter encounter transect was approximately 1 km in length. Transects were placed to be representative of general habitat types (e.g. grassland, dry forest, wetland) within the LSA. Eleven transects were selected to be surveyed: nine were located on property owned by KGHM, while the other two were located on private land. Each transect was to be surveyed two times during the winter of 2014.

A crew of two observers walked a pre-determined transect, looking and listening for any wildlife occurrence or sign. Each crew member walked at a distance of one metre from the center of the transect line, recording any sign observed within one metre of the line, and any animal observations that occurred within 10 metres of the line. Any observations outside of the boundaries were recorded, as well as the distance of the observation from the centre line. Locations of observations were recorded with a handheld GPS unit.

One crew member used a handheld GPS unit with transects previously loaded onto it to ensure that the line was followed as closely as possible, whenever safe to do so. The weather conditions (cloud cover, temperature, precipitation) at the start and end of each transect were recorded, as was the total distance covered.

Any wildlife sign (droppings/white wash, tracks, feathers, nests, dens, remains) detected was identified to species whenever possible. If the species could not be identified at the time of observation, a photo was taken. Any observations that could not be identified to species were recorded by type (e.g. deer, small mammal).

Bat Acoustic Surveys

Acoustic detection surveys for bats were conducted in 2007 and 2010 using handheld tuneable bat detectors (Mini-3 detector, Ultra Sound Advice; Petterson D230). Surveys were conducted according to the provincial *Inventory Methods for Bats* (Resources Inventory Committee (RIC) 1998e). Tuneable detectors cannot be used to distinguish between certain bat species that call at similar frequencies, but they can be used to establish presence/absence of bat activity in a particular area. Species and species groups were identified, where possible, based on the expected species presence and their known echolocation frequency.

Bat survey stations were located in potential foraging or roosting areas (wetlands, lakes, cliffs, older forest). Surveyors listened for five minute intervals to the bat detector tuned to 20, 30, and 40 kHz (15 minutes listening time at each survey station). The amount and type of bat activity detected was recorded on standard data sheets.

In 2008, an Anabat detector was used to survey a particular site that had not been previously surveyed and appeared to be suitable as a bat roost. Bat recordings from Anabat detectors often contain enough information that identification of the bat species or species group is often possible. Sound files were recorded of bats vocalizing as they emerged from the cliff. The Anabat call files were identified to species using the call characteristics and by comparing them with a reference library of known calls.

Additional surveys were completed in 2010 targeting the rock walls of the existing Ajax pits to assess their current use by roosting bats. Surveyors simultaneously monitored two tuneable detectors set at 30 and 40 kHz from dusk until full dark, the period during which bats would be emerging from day roosts.

A more extensive acoustic survey program was completed in 2014 to determine bat species present. Three Songmeter SM2 remote detectors (Wildlife Acoustics Inc.) were deployed under D-cell power at a number of locations to sample a variety of habitats. The detectors were equipped with ultrasonic microphones on a 1-m long extension cable and installed on trees, abandoned buildings or fenceposts. Detectors were programmed to begin recording at 30 minutes before sunset and turn off again at 30 minutes after sunrise. The recorded files were stored on SD cards mounted within the detector. The batteries and SD cards were replaced opportunistically during field visits, and the detectors were relocated periodically. The acoustic data were downloaded from the SD cards and converted to zero-crossing files using Wildlife Acoustics proprietary software. The zero-crossing files were sent to a bat expert for identification.

Additional acoustic surveys were done opportunistically during nocturnal road surveys for other wildlife (e.g. owls, amphibians). A portable EM3 acoustic detector (Wildlife Acoustics Inc.) was mounted on the survey vehicle and recorded bat activity throughout the survey. The EM3 time was synchronized with the time of the survey GPS so the location of any recorded bat files could be determined by cross-referencing the time of the acoustic file with the GPS track file. Data from the EM3 detector was downloaded and converted as described above and sent to the expert for identification.

14.3 Results

Small Mammal Live-trapping

Each of the six transects was trapped for two nights, with two traps per station for a total effort of 480 trap-nights (**Figure 14-1**). Captures totalled 77 small mammals, of which 76 were deermice *Peromyscus maniculatus* (**Plate 14-4**) and one was a yellow-pine chipmunk *Neotamias amoenus*. One deermouse was found dead in a trap. All other captures were released with no apparent ill effects to them. No pocket mice, or other small mammal species at risk, were detected. Forty-four small mammals were captured in Longworth traps, and 33 in Sherman traps.

The Great Basin pocket mouse has rarely been recorded in the Thompson valley near Kamloops (Nagorsen 2005). Factors limiting pocket mouse populations in the Kamloops area are unknown. The LSA's long history of disturbance due to industrial activity and livestock grazing may have affected local small mammal populations. Pocket mouse surveys were carried out in apparently suitable habitat in the Bunchgrass biogeoclimatic zone, as the potential footprints delineated for the Project included those areas at the time the surveys were done. The revised Project footprints do not affect suitable pocket mouse habitat (M. Sarell, pers. comm.) so no additional surveys were done.

Plate 14-4 Deermouse in Live-trap (L. Andrusiak photo)

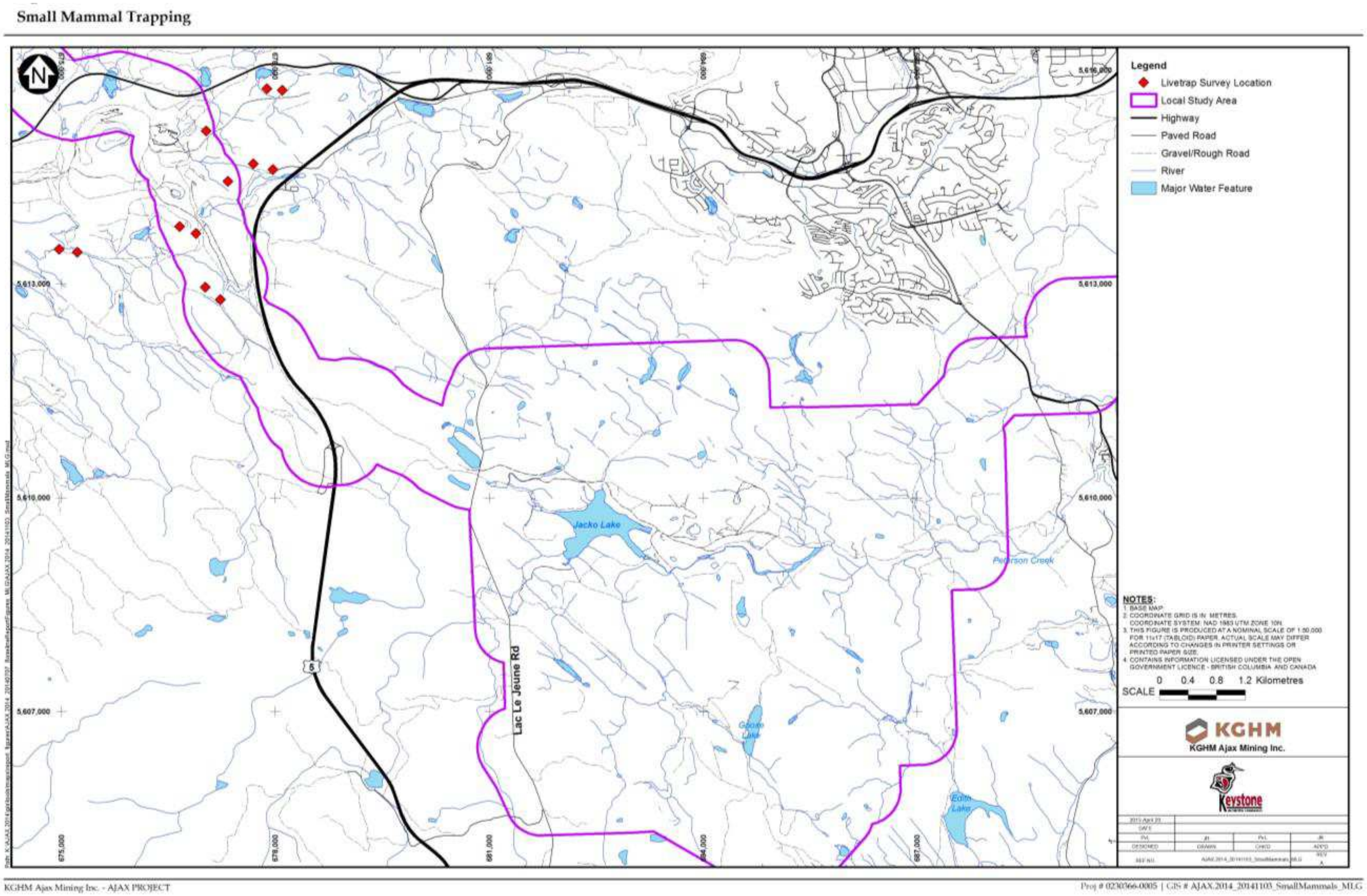

Figure 14-1 Small Mammal Trapping

Great Basin Pocket Mouse Habitat Suitability Mapping

The results of habitat suitability mapping for Great Basin pocket mouse in the TEM portion of the LSA are provided in **Figure 14-2** and summarized in **Table 14-1**. Most of the habitat within the LSA was rated Low to Nil, with some pockets of Moderate-suitability habitat around Wallender Lake and in the Bunchgrass zone on the eastern edge of the LSA.

Table 14-1 Habitat Suitability for Great Basin Pocket Mouse

Habitat Suitability	Ha in TEM portion of LSA	% of TEM portion of LSA
Moderate	488.6	8.2
Low	3,496.1	58.8
Nil	1,958.8	33.0
TOTAL	**5,943.6**	

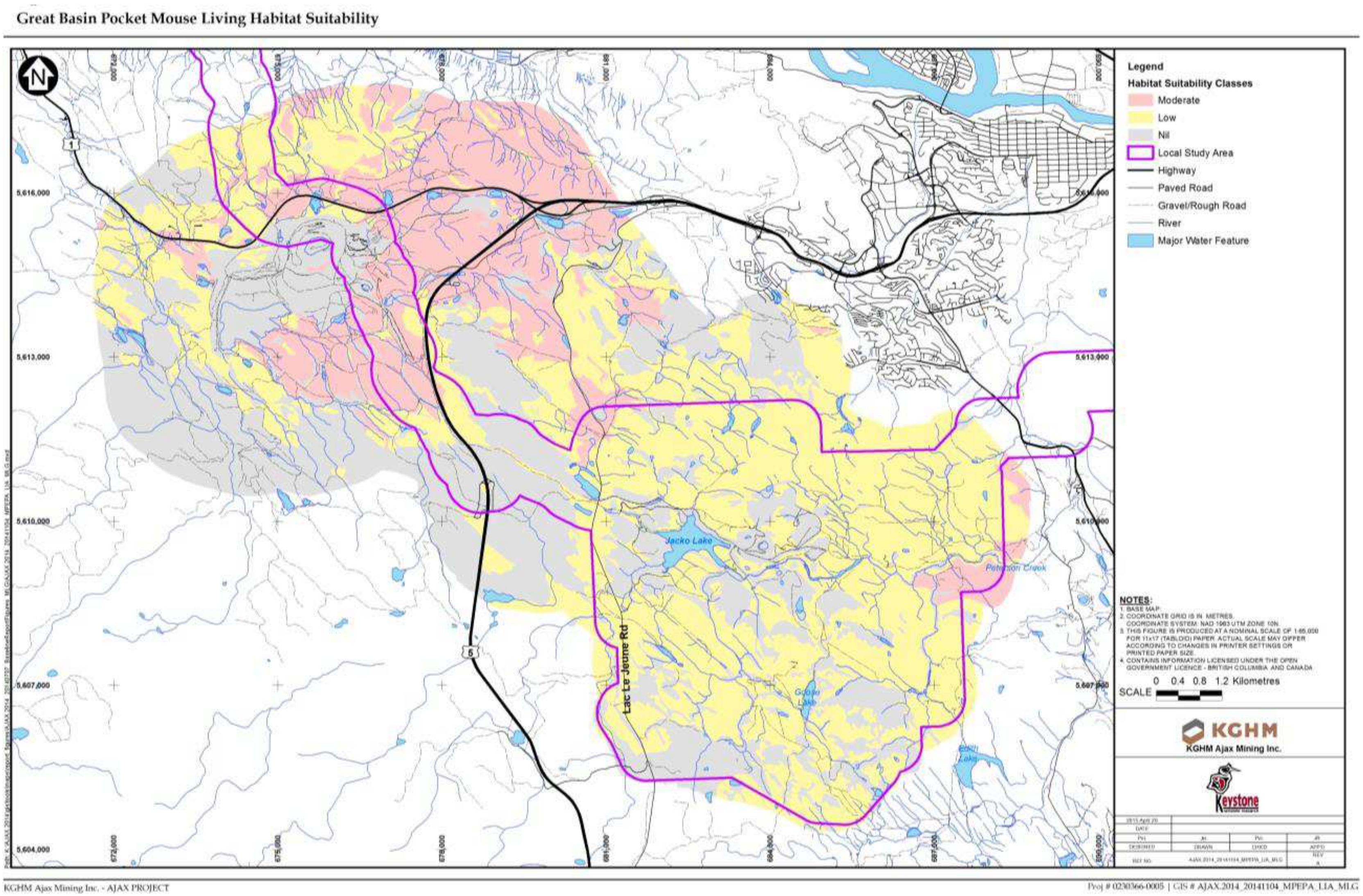

Figure 14-2 Great Basin Pocket Mouse Living Habitat Suitability

Badger Den Investigation and Hair Snagging

Badger dig sites (**Plate 14-5, Figure 14-3**) located during the course of other field surveys were visited during July 24-25, 2011, by badger expert Richard Klafki and a Keystone Wildlife Research biologist. Eighteen sites were examined (**Table 14-2**) in and around the LSA. Two of the sites had very recent activity (less than one week) and seven more had been used in 2011. In total, 31 badger dig sites (some with multiple entrances) were located during all field surveys from 2008 to 2014 (**Figure 14-3**). Eleven of those sites were noted as 'collapsed and unused' during 2014 surveys.

Plate 14-5 Badger Dig Site (L. Andrusiak photo)

Table 14-2 Badger Dig Sites Visited During Summer 2011

Dig ID Label	Visit Date	Comments
1	July 24	Recent badger activity, less than 1 week old
2	July 24	
3	July 25	
4	July 25	Badger use in 2011
5	July 25	Badger use in 2010
6	July 25	Badger use; not recent
7	July 25	Badger use in 2011; wider than others
8	July 25	Older, no recent activity
9	July 25	Badger use in 2011
10	July 24	Badger use in 2011

Dig ID Label	Visit Date	Comments
11	July 24	
12	July 24	Badger use in 2011; hair observed at entrance
13	July 24	Den plugged from inside spring 2011 and not unplugged - possible mortality as no other exits found
14	July 24	Badger use in 2011
15	July 24	
16	July 24	Recent coyote use, possibly badger activity
17	July 24	Recent badger use, less than 1 week old
18	July 25	Used within last 2 years; structurally good

Fifteen hair-snaggers were installed on August 24 and 25, 2014. They were retrieved on October 1, 2014. None of the digs visited showed any outward evidence of fresh badger use. Minimal amounts of hair were recovered at three sites. The hair samples were sent to Wildlife Genetics International (Nelson, BC) for genetic analysis. DNA was extracted using QIAGEN DNeasy Tissue kits, and following the manufacturer's instructions. The first phase of genetic analysis was a species test comprised of a partial sequence analysis of the mitochondrial 16S rRNA gene. After a second round of analysis to confirm a weak first-pass result for 1 sample, all 3 samples were confirmed to be from badgers (D. Paetkau, pers. comm.).

The analysis of individual identity began with a first pass of seven microsatellite markers that were used in previous badger projects from the Kamloops area. All three samples failed on the first attempt and were analyzed a second time using 5 µL of DNA, instead of the standard 3 µL used on the first pass. Once again, all three samples failed to produce genotypes suitable for individual identification. Although all three samples were confirmed as badger, there was insufficient material to obtain individual identification.

The results of the snagging program show that:

- Badgers may occupy dig sites on the LSA without leaving any visible evidence of their presence

- Hair-snagging may be a simple, non-invasive and low-cost technique for future monitoring of badger use of the LSA. Consideration should be given to leaving the snaggers out for longer periods of time, and possibly installing multiple snaggers within a single dig in order to maximize the chances of collecting sufficient hair.

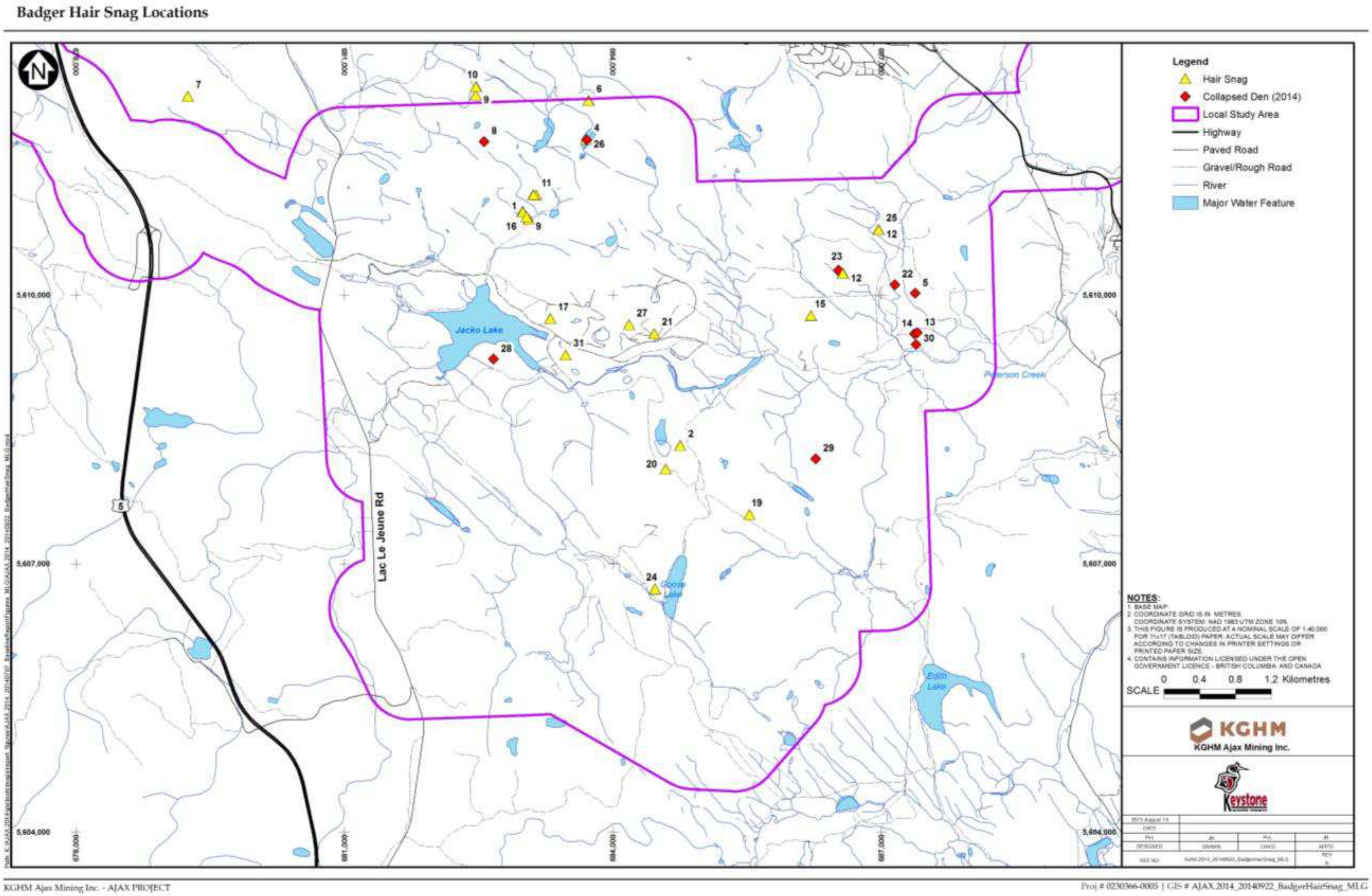

Figure 14-3 Badger Hair Snag Locations

Badger Habitat Suitability Mapping

The results of the habitat suitability mapping for badgers in the TEM portion of the LSA is presented in **Figure 14-4** and summarized in **Table 14-3.** Over 4,229 ha of high and moderate-suitability badger living habitat was mapped. The highest-suitability habitat is concentrated around the northwestern and southeastern ends of the study area. Badgers use a variety of grasslands and dry forests for foraging and resting, and badgers have been observed in the LSA. Ritcey et al. (1988) estimated that 800 ha per badger is required in summer to meet feeding and reproductive needs.

Table 14-3 Badger Living Habitat Suitability in the TEM Portion of the LSA

Habitat Suitability	Ha in TEM portion of LSA	% of TEM portion of LSA
High	2,728.0	45.9
Moderate	1,501.3	25.3
Low	512.7	8.6
Nil	1,201.5	20.2
TOTAL	**5,943.6**	

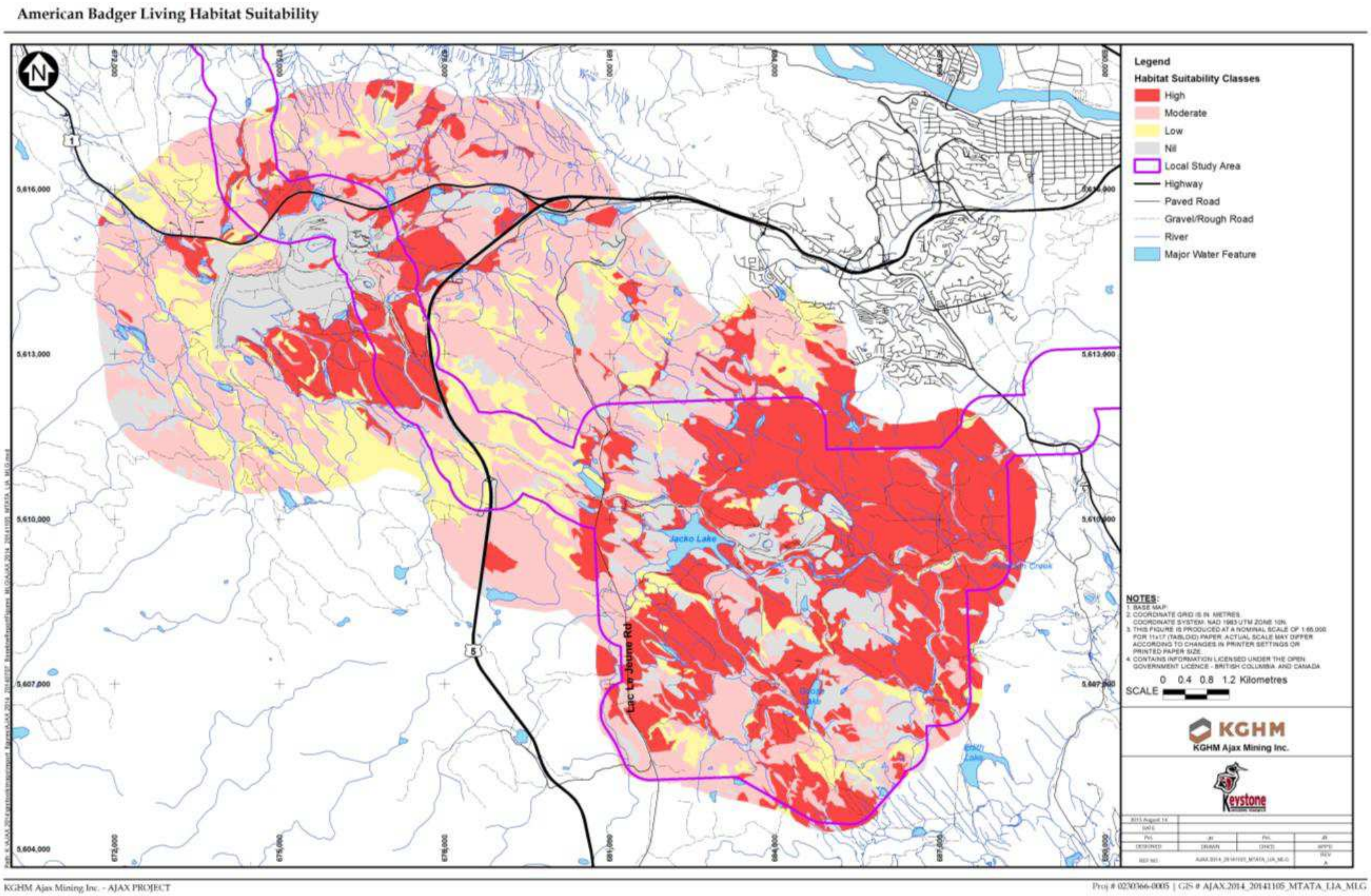

Figure 14-4 American Badger Living Habitat Suitability

Ungulate Data Review

Ungulate winter ranges are areas on the landscape that deer and moose travel to in response to snow accumulation. Deer may migrate long distances to reach them (Ungulate Winter Range Technical Advisory Team 2005). Deer winter ranges generally have:

- abundant winter forage to maximize energy intake;
- minimal snow depths to minimize energy expenditure for movement; and
- sufficient hiding cover to conceal deer from predators.

Snow deeper than about 24 cm may impede movements of deer and cause them to move to winter ranges (*ibid*.). Snow deeper than chest height is generally not tolerated by any ungulate species, unless the snow conditions allow for the snow to support the ungulates weight. Wetter, warmer winters will reduce snow sinking depths, while drier, colder conditions, like those found in the interior, will likely result in sinking depths being equal to snow depths.

The Kamloops LRMP (Kamloops Interagency Management Committee 1995) identified critical deer winter range (DWR) that included 859.6 ha within the LSA (**Table 14-4**). No critical moose winter range (MWR) was identified in the LSA. The LSA includes 896.3 ha that has been identified by the Ministry of Environment as mule deer winter range in a more recent ungulate winter range designation and incorporated into draft winter range planning cells (**Figure 14-5**). The majority of the planning cell area in the LSA is located east of Inks Lake, southwest and east of the TSF footprint, and south of Jacko Lake.

Table 14-4 Ungulate Winter Range Areas Within the LSA and RSA

Winter Range Type	LSA (ha)	RSA (ha)
Critical DWR (LRMP)	859.6	37,255.7
Critical MWR (LRMP)	0	2,467.5
Draft Mule Deer Planning Cells	896.3	35,912.4

During April field surveys, groups of 11-15 deer were sighted on spring range on the grasslands (**Plate 14-6**). Snow melts earlier on these areas, which are the first to green up in the spring. Moose were not directly observed during field surveys but pellet groups (**Plate 14-7**) were recorded in areas close to forested cover. Moose rarely venture into grasslands but prefer forest and shrubby wetland areas.

Ungulates crossing roads and highways in the vicinity of the Project are vulnerable to roadkills, especially at night. One roadkilled deer was observed during winter 2014 surveys, on Lac le Jeune Road near the Sugarloaf Ranch Road turnoff, outside of the LSA. The BC Ministry of Highways and Infrastructure’s latest roadkill summary report (Sielecki 2010) was reviewed but detailed data for the area around the Project were not available.

Plate 14-6 Mule Deer on Grasslands During Green-up (C. Albrecht photo)

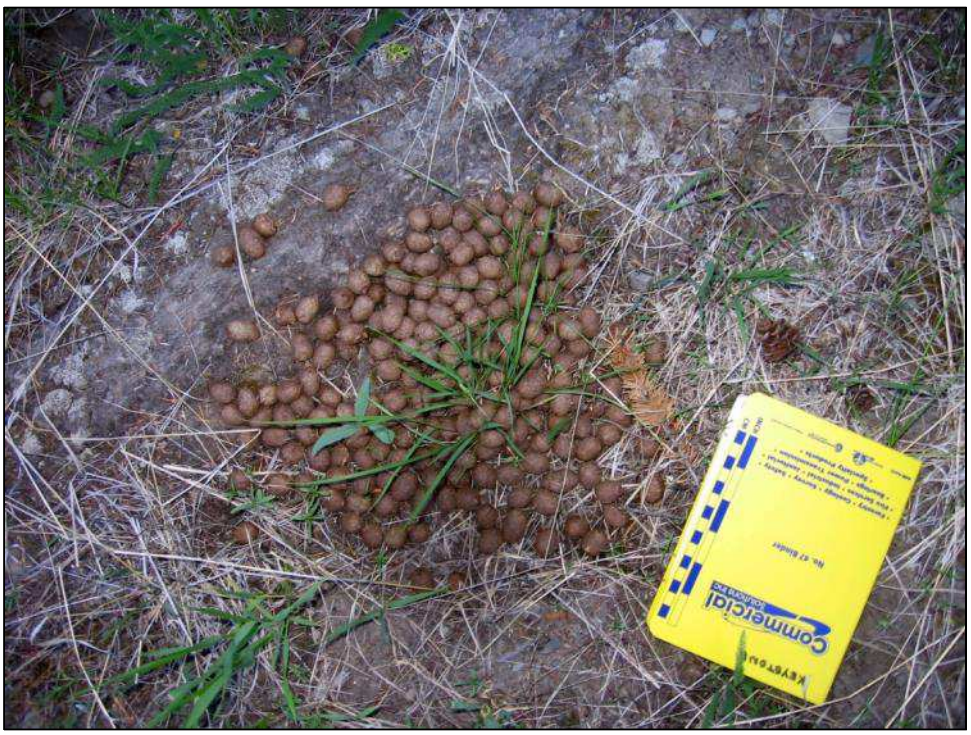

Plate 14-7 Moose Pellets (L. Andrusiak photo)

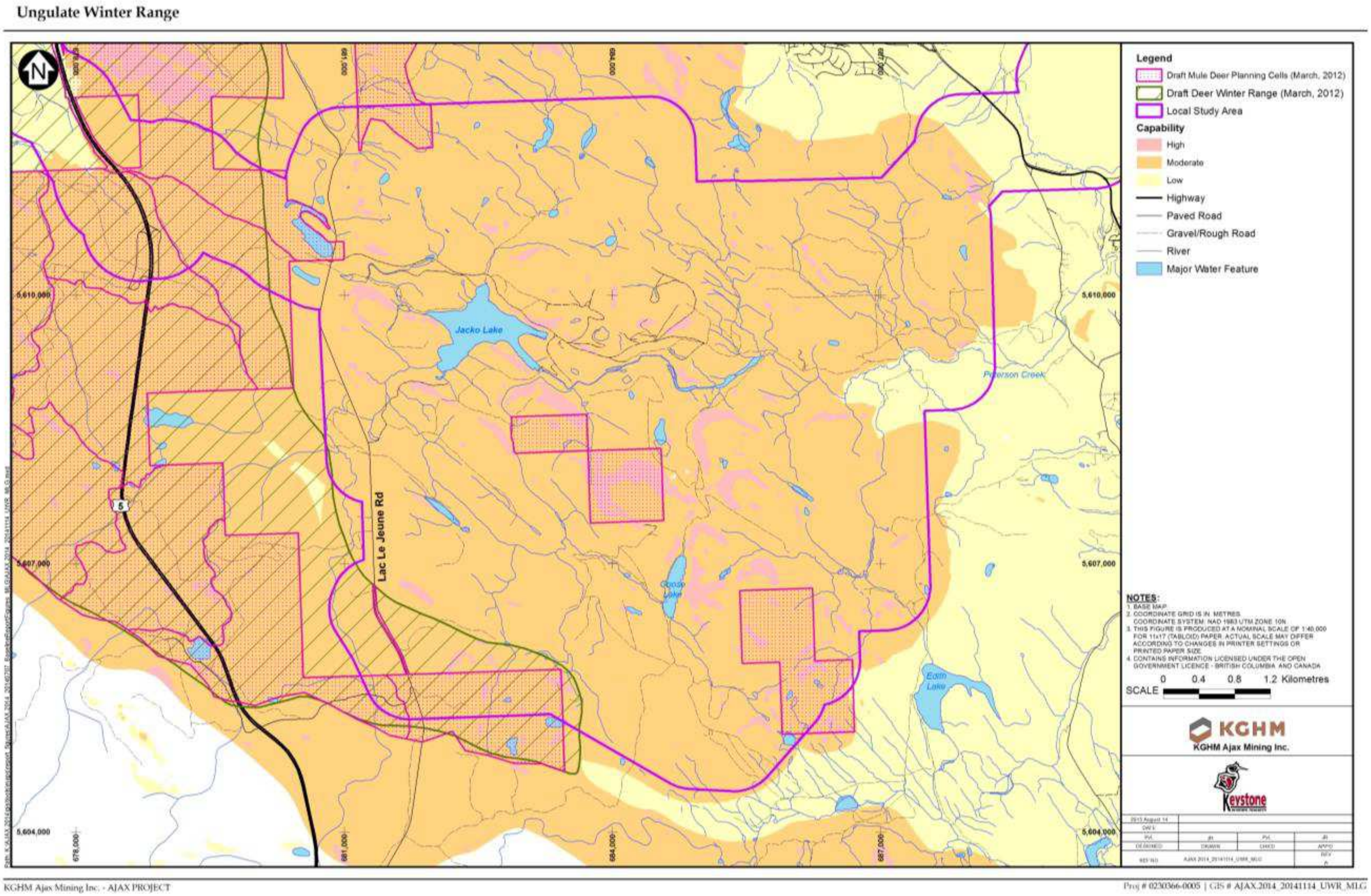

Figure 14-5 Ungulate Winter Range

Winter Encounter Transects

Eleven transects were surveyed in 2014 (**Figure 14-6)**, with visits on February 18-19 and March 18-19. In February, nine of the eleven transects were surveyed, covering 10.7 km over 6 hours and 13 minutes; in March, ten of the eleven transects were surveyed again, covering 10.9 km over 5 hours and 38 minutes, for a total survey effort of 21.6 km over 11 hours and 51 minutes (**Table 14-5**). Snow was present on the ground during both surveys. The most recent significant snowfall occurred 8 to 9 days before the February surveys and 12 to 13 days before the March surveys.

Table 14-5 Summary of Wildlife Encounter Foot Transect Survey Effort

Transect Name	Total Time (hr:min)	Total Distance (km)
	February 2014	
A	0:34	1.1
B	0:25	1.1
C	0:26	1.2
D	0:24	1.0
E	0:34	1.0
F	0:45	1.2
G	1:07	1.5
H	0:56	1.4
I	1:02	1.2
	March 2014	
A	0:33	1.1
B	0:21	1.1
C	0:19	1.0
D	0:29	1.0
E	0:53	1.1
F	0:47	1.1
G	0:42	1.4
I	0:37	1.0
J	0:27	1.1
K	0:30	1.0
Grand Total	11:51	21.6

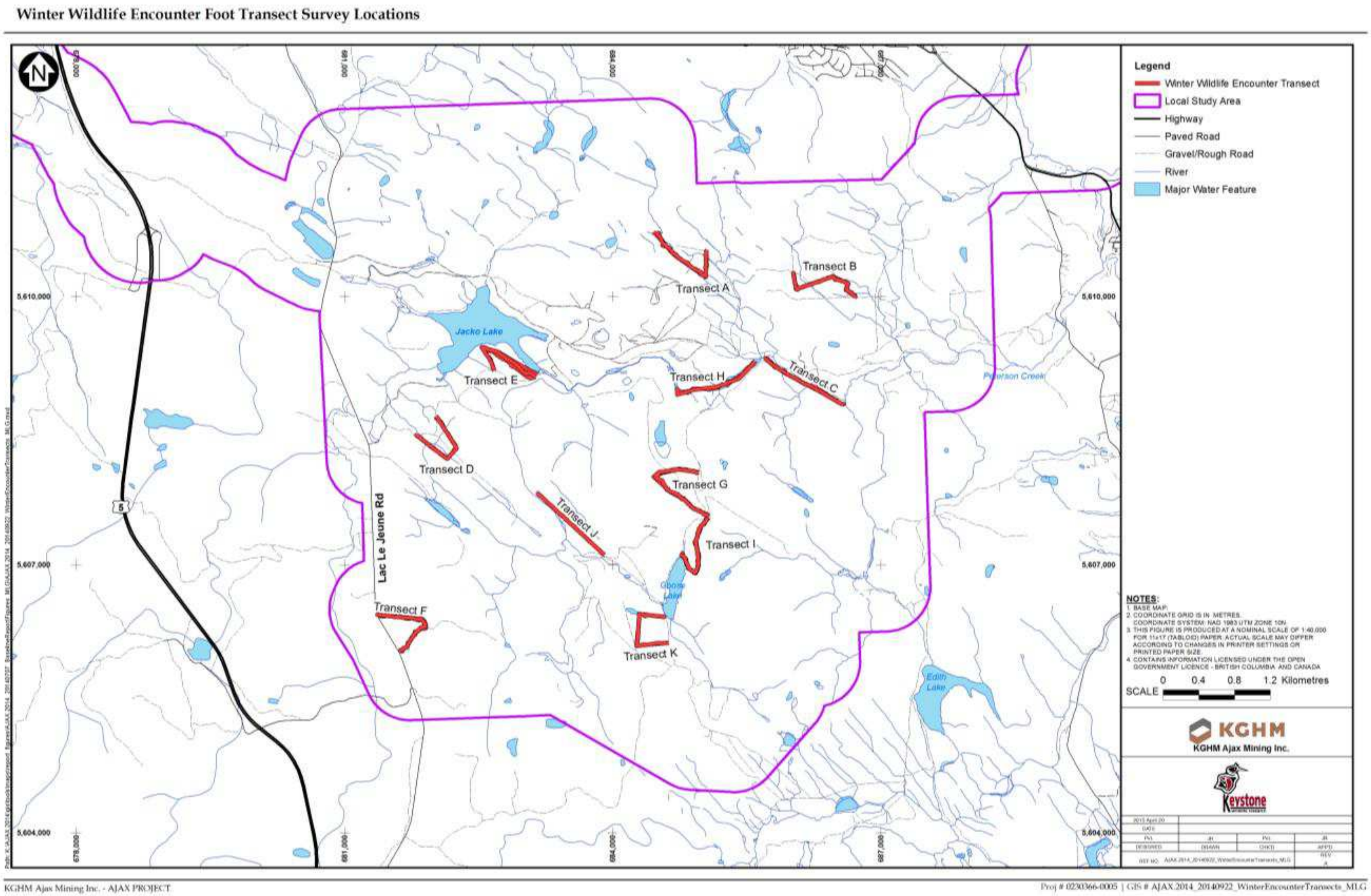

Figure 14-6 Winter Wildlife Encounter Foot Transect Survey Locations

Two transects were not surveyed in February as they were located on private land. Once permission to enter those areas was received, the two private land transects were added to the survey schedule. In March, one transect (H) was not surveyed due to environmental conditions and time constraints.

The majority of mammal observations on the winter encounter transect surveys was deer and coyote sign. Little evidence of deer was noted during the February surveys when only two transects had deer tracks and no pellet groups were found. The highest density of deer pellets was observed on Transect I, a transect with steep, rocky Douglas-fir forest in proximity to open warm aspects.

Moose sign was also observed with five pellet groups recorded, as well as one site with apparent moose browse. Moose pellets were noted on transect F (in the southwest corner of the LSA) and on G and K transects north and south of Goose Lake, respectively. Over 20 coyote tracks and 15 separate scat piles were recorded. Deer remains were also found at a coyote kill site on Peterson Creek in February. Eleven sets of mustelid tracks (either ermine *Mustela erminea* or long-tailed weasel *Mustela frenata*) were recorded during the encounter transect surveys. Various small mammal tracks (mice, voles, squirrels) were observed as well, however most of these were not recorded as they were very common.

Recent black bear scat was observed in March. One porcupine was observed in March, at the beginning of Transect 'F'.

Bat Acoustic Surveys

Fourteen bat acoustic survey stations were completed in 2007 at Jacko Lake, Goose Lake, Pothook Lake, Crescent-Afton (pit), Ajax East (pit), Ajax West, Inks Lake, and Peterson Creek (**Figure 14-7**). Surveys took place on the nights of June 25, June 26, July 7 and July 8, 2007. The weather ranged from clear to cloudy, with no precipitation. Ambient temperatures were between 12°C and 20°C. Bat activity was detected at Goose Lake (one big brown bat *Eptesicus fuscus* or silver-haired bat *Lasionycteris noctivagans*; these two species cannot be reliably distinguished with acoustic detectors) and over the pond within the Crescent-Afton pit (two hoary bats *Lasiurus cinereus*). No other bats were detected in 2007. During the snake hibernaculum surveys in 2008, a myotis bat (most likely either fringed myotis or Yuma myotis) was discovered roosting under a boulder on the slope between the haul road and Jacko Lake, but it escaped before it could be positively identified.

During the bird survey in May 2008, an additional rock outcrop adjacent to a pond (Wetland 10) was located near the eastern edge of the Ajax South Mine Rockpile. That rock outcrop was revisited at sunset August 13, 2008. A handheld tuneable bat detector and a recording broad-band Anabat bat detector were used to survey for calling bats for 1 hour 19 minutes. The resulting Anabat sound files were analyzed by comparison to reference calls available on-line. Foraging silver-haired bats or big brown bats were detected over the lake, and Myotis species were detected emerging from roost sites within the rock outcrop. Confirmation of identification of Myotis bats by their calls cannot be done with certainty, but the calls of the Myotis bats were most similar to reference calls of long-eared myotis (*Myotis evotis*). Rescan (2006) also reported detections of little brown myotis (*Myotis lucifugus*) near the tailings pond (Hughes Lake).

Two additional sampling stations were completed on June 22, 2010, to check for bat roosting within the walls of the Ajax East pit. The weather was clear and warm (19^{o}C). Two bat detectors were monitored simultaneously, one set to 30 kHz and one at 40 kHhz, at each of two stations. One station was located at the existing adit in the east wall of the Ajax East pit, and another was located near potential roost fissures in the west wall of the pit. Both stations were monitored from 21h31 to 22h15, during the period when bats would be emerging from day-roosts.

Two bat passes were recorded at 40 kHz under the adit. Both passes were regular search-phase passes characteristic of travelling bats, rather than the irregular calls of bats preparing to leave a roost. No activity suggestive of roosting bats was observed.

Ten sites (Error! Reference source not found.) were sampled with Songmeter acoustic detectors in 2014 (**Plate 14-8)**. In total, 13,503 bat files (**Plate 14-9)** were obtained from the detectors, of which 331 could be assigned with confidence to particular species (**Table 14-6**). An additional 495 files were identified as one of two species (big brown bat or silver-haired bat).

Bat Detector Locations

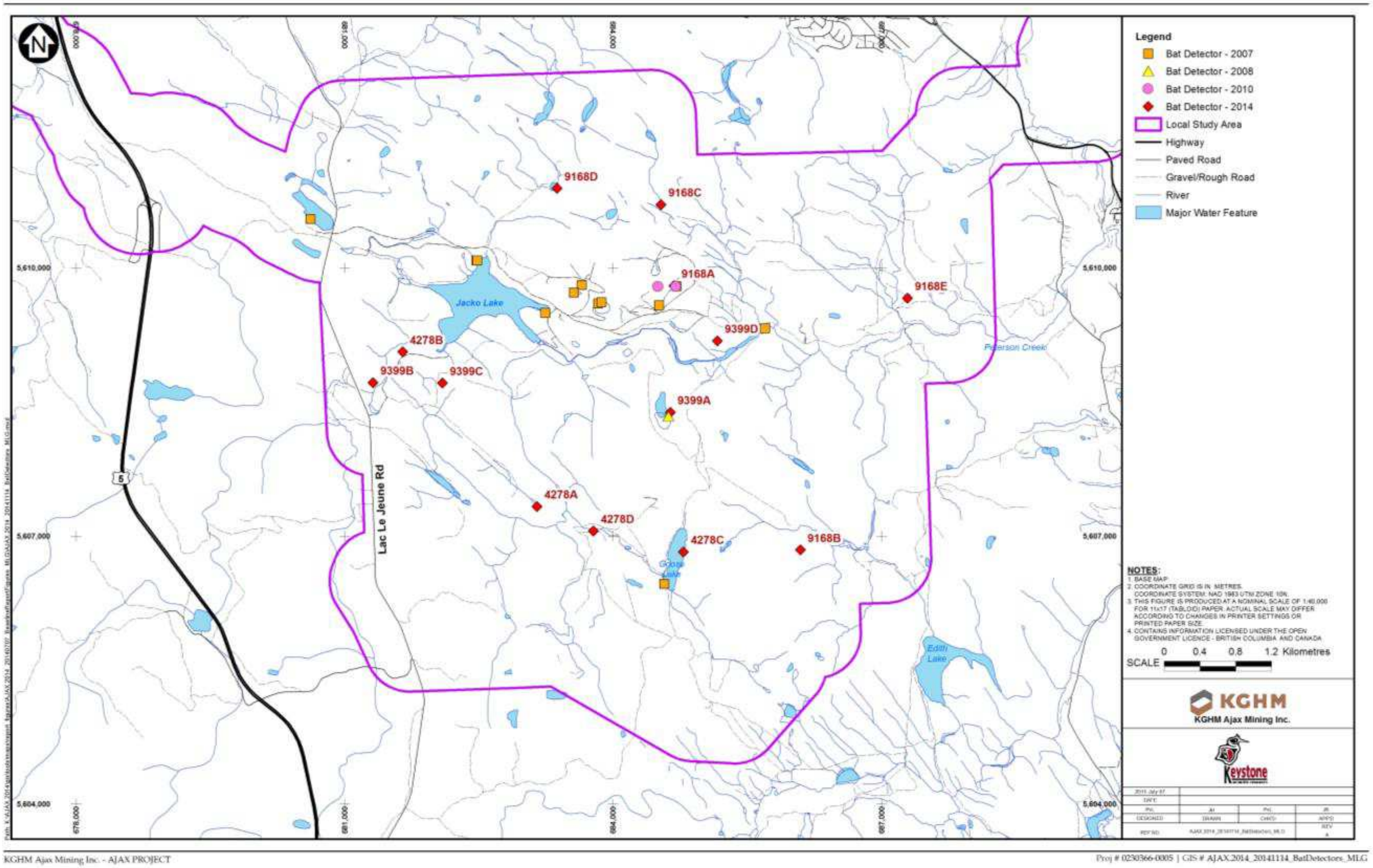

Figure 14-7 2007-2014 Bat Field Surveys

Plate 14-8 Bat Detector on Tree at Goose Lake (L. Andrusiak photo)

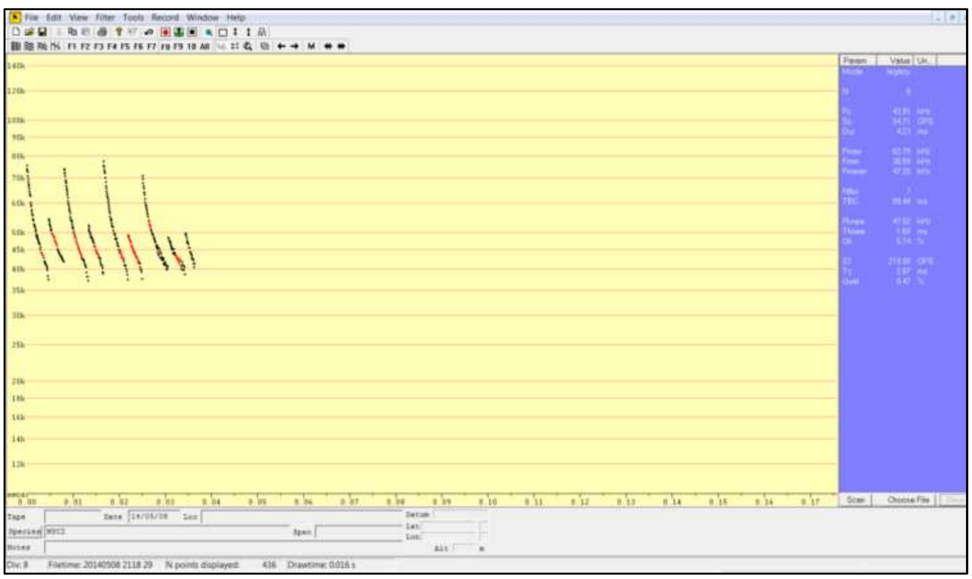

Plate 14-9 Western Small-footed Myotis Acoustic File Displayed in AnaLook

Table 14-6 Bat Species Recorded on Remote Detectors in 2014

Species	Numbers of Acoustic Files by Detector Site										
	4278A	4278B	4278C	9168A	9168B	9168C	9168D	9399A	9399B	9399C	Total files
Fringed myotis			42						3	1	46
Silver-haired bat/ big brown bat	38	40	120	9	9	21	110	38	65	45	495
Silver-haired bat		2				2	2	1		6	13
Western small-footed myotis	5	2	4				6				17
Little brown myotis	15	54	52			2	85	10	14	23	255
Myotis35- long-eared myotis (*M. evotis*) or little brown myotis	2	32	5	13	7	32	8	17	6	8	130
Myotis40- little brown bat, western small-footed myotis and long-legged myotis (*Myotis volans*)	276	3399	686	2	16	582	1361	158	359	148	6987
Myotis50 - Yuma myotis (*Myotis yumanensis*) and Californian myotis (*M. californicus*)	3	1223	24		1		11	3	17		1282
Unspecified Myotis	58	1330	76		80	1150	509	78	28	14	3323
Unspecified big bat	7	59	33	4	6	9	75	23	55	35	306
Unspecified bat	41	225	83		21	2	150	44	60	23	649
Grand Total	445	6366	1125	28	140	1800	2317	372	607	303	13503

Two Blue-listed bat species were recorded on the remote detectors. The fringed myotis was detected at site 4278B at Goose Lake where 46 files were recorded. This species frequently forages over water (BC Ministry of Water, Land and Air Protection 2004). Three more files identified as fringed myotis were recorded at sites 9399B and 9399C southwest of Jacko Lake. The maximum number of fringed myotis files recorded in a single night at a single detector was 8.

The Blue-listed western small-footed myotis was recorded at four sites at wetlands, alkaline ponds or lakes (Table **14-6**). Like the fringed myotis, it is also a species that forages over riparian habitats (Garcia et al. 1995). The maximum number of small-footed myotis files recorded in a single night at a single detector was 3.

The remaining bat species recorded are all provincially Yellow-listed. These include the silver-haired bat, long-legged myotis (*Myotis volans*) and little brown myotis. The little brown myotis is listed as Endangered by COSEWIC due to the effects of white-nose syndrome on populations in eastern Canada. The big brown bat is likely also present. Recordings of this species cannot be reliably distinguished from those of the silver-haired bat but the big brown is a very common and widely-distributed species.

The 'Myotis50' category includes calls with a characteristic frequency of approximately 50 kHz. This category includes the Yuma myotis (*Myotis yumanensis*) and Californian myotis (*M. californicus*). Both of these are Yellow-listed.

The 'Myotis40' category includes calls with a characteristic frequency of about 40 kHz but with calls too steep and high sloped or inadequate call sequence to characterize to species level. Species included in this group are the little brown myotis, western small-footed myotis and long-legged myotis.

The 'Myotis35' category includes very steep calls with a characteristic frequency of about 35 kHz. This category includes the long-eared myotis (*M. evotis*) and little brown myotis. Some steep little brown myotis calls can be this low in frequency.

The category 'Bat' includes calls that are identifiable as being produced by a bat but are of insufficient quality to assign to any of the more specific categories

Incidental Mammal Observations

Mammalian wildlife species detected opportunistically during field surveys are included in **Appendix 7.** Coyotes were observed denning in the EMRSF footprint (**Plate 14-10**). Incidental mammals included yellow-bellied marmot (*Marmota flaviventris;* **Plate 14-11**), red fox (*Vulpes vulpes;* also breeding in the grasslands north of Peterson Creek), yellow-pine chipmunk (**Plate 14-12**), and porcupine.

Plate 14-10 Coyote Pups at Den (L. Andrusiak photo)

Plate 14-11 Yellow-bellied Marmots (L. Andrusiak photo)

Plate 14-12 Yellow-pine Chipmunk (L. Andrusiak photo)

KGHM staff also reported incidental wildlife sightings. The most notable of these included multiple sightings of a single badger near the haul road between Jacko Lake and the Ajax pits, and a cougar (*Puma concolor*).

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APPENDIX 1 BIOTERRAIN LEGEND

Terrain Polygon Symbols
surficial material ↘↙ initiation zone texture → aCk-R"b ← geomorphological process subclass surface expression ↗↖ geomorphological process
Note: one or more letters may be used to describe any characteristic other than surficial material, or letters may be omitted if information is lacking. Composite Units: Two or three groups of letters are used to indicate that two or three kinds of terrain are present within a map unit. e.g., 7Mv 3Rs indicates that the polygons contains approximately 70% "Mv" and 30%"Rs". e.g., 6Mb 3Cv 1Rs indicates that the polygons contains approximately 60% "Mb" , 30%"Cv", and 10% “Rs”. Stratigraphic Units: Groups of letters are arranged one above the other where one or more kinds of surficial material overlie a different material or bedrock: e.g., Mv indicates that "Mv" overlies "Rr". Rr

Material			Texture			Surface Expression	
Code	Name		Code	Name		Code	Name
A	Anthropogenic		c	clay		a	moderate slope(s)
C	Colluvium		z	silt		b	blanket (>1m thick)
C1	Slope wash		s	sand		c	cone
D	Weathered bedrock		p	pebbles		d	depression
E	Eolian		k	cobbles		f	fan
F	Fluvial materials		b	boulders		h	hummocky
FA	"Active" fluvial materials		a	blocks		j	gentle slope(s) (5-27%)

FG	Glaciofluvial materials		d	mixed fragments		k	moderately steep slope (49-70%)
L	Lacustrine sediments		g	gravel		m	rolling topography
LG	Glaciolacustrine sediments		r	rubble		p	plain (0-5%)
M	Till		x	angular fragments		r	ridges
N	Nonclassified, eg. lake		m	mud		s	steep slope(s) (>70%)
O	Organic materials		y	shells		t	terrace(s)
R	Bedrock		e	fibric		u	undulating topography
U	Undifferentiated materials		u	mesic		v	veneer (<1m thick)
			h	humic		w	mantle of variable thickness
						x	thin veneer (10-25 cm)

Geological Processes	
Code	Name
-E	Glacial meltwater channels
-F	Slow mass movement (failing, slumps)
-F"	Slow mass movement initiation zone
-Fk	tension cracks
-Fx	slump-earthflow (slow mass movement)
-G	Ground disturbance (anthropogenic)
-R	Rapid mass movement (slides and falls)
R"	Rapid mass movement initiation zone
-Rb	Rockfall
-Rx	slump-earthflow (rapid mass movement)
-U	Inundation- seasonally under water due to high water table
-V	Gully Erosion

Drainage	
Code	Name
x	very rapidly drained
r	rapidly drained
w	well drained

m	moderately well drained
i	imperfectly drained
p	poorly drained
v	very poorly drained
Where two drainage classes are shown: • if the symbols are separated by a comma, e.g., "w,i", then no intermediate classes are present; • if the symbols are separated by a dash, e.g., "w-i", then all intermediate classes are present.	

APPENDIX 2 TEM MAP LEGEND

KGHM-Ajax

Terrestrial Ecosystem Mapping of the Ajax Study Area

Portions of map sheets 092I.068, 092I.069, 092I.058, 092I.059

Scale 1:20,000

October 2014

1. INTRODUCTION

The Ajax study area is located in south-central British Columbia, just east of the city of Kamloops, and is approximately 10,772 ha in area. The mapped area includes portions of TRIM map sheets 092I.068, 092I.069, 092I.058, and 092I.059, and is within the Kamloops Forest District in the Southern Interior Forest Region. Ecosystem mapping was originally requested by Abacus Mining and Exploration Company as base mapping for identifying habitats of priority wildlife species.

The ecosystem mapping methodology used is based upon that used for standard Terrestrial Ecosystem Mapping (TEM) Resources Inventory Committee (1998a). There are three levels of ecosystem classification applicable to this map: the ecosection unit, biogeoclimatic units (subzones) and ecosystem units. Ecosections are large physiographic units influenced by particular macroclimate processes and are characterized by all the plant communities and wildlife populations present (Demarchi 1996). The biogeoclimatic ecosystem classification system (BEC) describes the variation in climate, vegetation and site conditions occurring within an ecosection, and divides the area into subzones and their variants. Ecosystem units are defined for each subzone and are indicated in the map label by a two or four-character code, with site modifiers if applicable, followed by the structural stage at the time the area was mapped. Vegetated ecosystems were mapped according to Lloyd et al. (2005), while non-vegetated/anthropogenic ecosystems were mapped according to RIC (1998b).

The mapped area falls within the Thompson - Okanagan Plateau ecoregion. The mapped area includes one ecosection and four subzone variants.

2. MAP BOUNDARIES

Ecosection Boundary

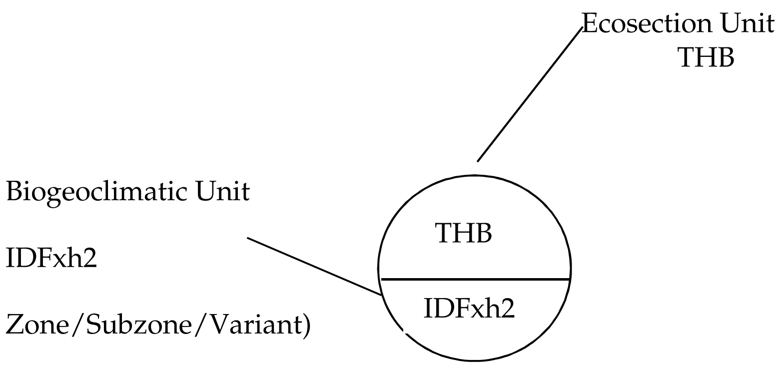
Study Area Boundary

Subzone Boundary

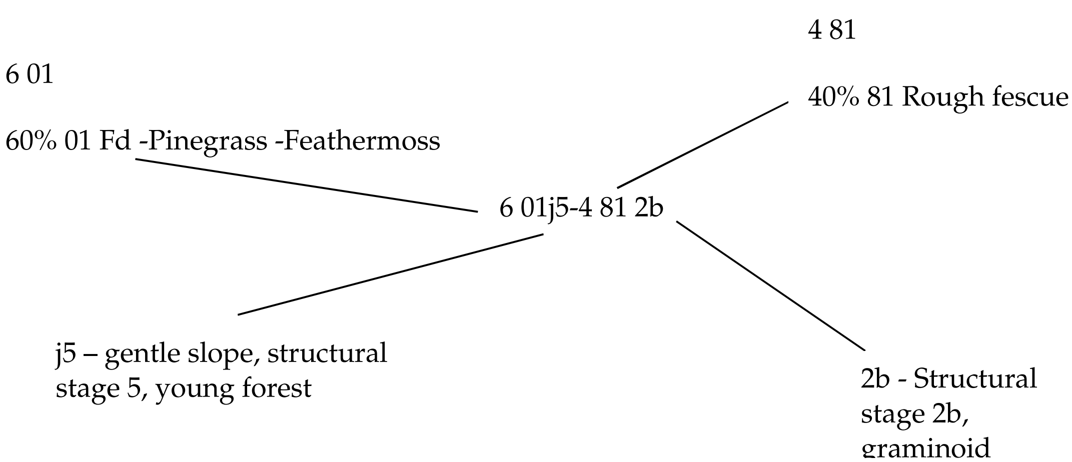
Ecosystem Map Unit

3. MAP LABEL FORMAT

Ecosection and Biogeoclimatic Unit Label



Ecosystem Unit Label



4. ECOSECTION

Thompson Basin (THB)

The THB ecosection is a warm and very dry, low-elevation area of predominantly gentle slopes (Demarchi 1996).

5. BIOGEOCLIMATIC SUBZONE VARIANTS

Ponderosa Pine very dry hot, Thompson variant (PPxh2)

The PPxh2 is found at elevations from 400-1050 m (depending on aspect). The dominant tree species is ponderosa pine (*Pinus ponderosa*), with Douglas-fir (*Pseudotsuga menziesii*) present on cool aspect or moist sites. Paper birch (*Betula papyrifera*) and black cottonwood (*Populus balsamifera*) are found on moist riparian areas, and saskatoon (*Amelanchier alnifolia*) and rose (*Rosa*) are common understorey shrubs. Grasslands are common where soil texture is fine and on steep warm aspects. Rough fescue (*Festuca campestris*) and bluebunch wheatgrass (*Pseudoroegneria spicata*) are the most common native grasses, and big sage (*Artemisia tridentata*) is common. Wetlands are dominated by saltgrass (*Distichlis spicata*), cattails (*Typha*), bulrushes (*Scirpus*) and sedges (*Carex*) (Lloyd et al. 2005).

Interior Douglas-fir very dry hot, Thompson variant (IDFxh2)

The IDFxh2 is found at 400-1300 m in elevation, and is primarily forested with Douglas-fir with a component of ponderosa pine. Paper birch and cottonwood also occur. Common shrubs include snowberry (*Symphoricarpos alba*), rose, saskatoon and birch-leaved spirea (*Spiraea betulifolia*) (Lloyd et al. 2005).

Bunchgrass very dry, hot, Thompson variant (BGxh2)

The BGxh2 occupies areas of 250-800 m in elevation. It has hot, dry summers and mild, dry winters, with little snow. Landscapes are generally dominated by grassland and sagebrush ecosystems, and trees (ponderosa pine, Douglas-fir, cottonwood, aspen (*Populus tremuloides*) are rare and occur only on moister sites and gullies. Bluebunch wheatgrass and big sage are the most common vegetation species (Lloyd et al. 2005).

Bunchgrass very dry warm, Nicola variant (BGxw1)

The BGxw1 is found at elevations of 650-1050 m, above the BGxh2, and has more forested area than the BGxh2. Closed stands of ponderosa pine and Douglas-fir occur on steep north aspects and on coarse-textured soils. Trembling aspen and cottonwood are disclimax species. Grasslands are dominant climax communities, with some shrubs (big sage, rabbitbrush (*Ericameria nauseosa*), rose) present in mid-seral communities (Lloyd et al. 2005).

6. MAPPED SITE SERIES

Map Symbol	Name	Description	Moisture Regime
BGxh2			
02	FdPy-Bluebunch wheatgrass-Selaginella	Open FdPy stands on cool slopes, abundant bluebunch wheatgrass, moderate shrub cover.	Subxeric-submesic
03	PyFd-Bluebunch wheatgrass	Open Fd and Py stands, low shrub cover, abundant bluebunch wheatgrass. Gentle slopes or warm aspects.	submesic-mesic
04	FdPy-Snowberry	FdPy stands with a diverse shrub layer; seepage present; gullies and lower slopes.	subhygric
81	Big sage-Bluebunch wheatgrass	Dry grasslands, sagebrush often present. variable slope positions	submesic -mesic
83	Big sage-Bluebunch wheatgrass-Selaginella	Crests and upper slopes. Morainal or colluvial parent materials. Abundant herb layer dominated by bluebunch wheatgrass.	xeric - subxeric
84	Rabbit-brush-Bluebunch wheatgrass-Selaginella	Usually steep cool slopes. Morainal or glaciofluvial parent materials. Abundant herb layer dominated by bluebunch wheatgrass.	subxeric - xeric
85	Big sage-Indian ricegrass	Level to gentle slopes on glaciofluvial materials	xeric
Ro02	Bluebunch wheatgrass-Selaginella	Shallow soils over bedrock, crests and upper slopes. Sparse shrub layer, sparse to abundant herb layer dominated by compact selaginella.	very xeric - xeric

Map Symbol	Name	Description	Moisture Regime
BGxw1			
02	PyFd - Bluebunch wheatgrass	Dry forest on upper warm slopes on colluvial or morainal materials.	subxeric - submesic
03	Fd - Bluebunch wheatgrass - Rough fescue	Typically open forest on steep, cool middle to upper slopes on colluvial or morainal materials.	submesic - mesic
04	Fd- Snowberry - Step moss	Fd forest on cool slopes or gullies, on colluvial, morainal or glaciofluvial materials.	mesic - subhygric
05	At- Snowberry - Kentucky bluegrass	Deciduous forest occurring on gentle slopes or level areas with seepage.	subhygric - mesic
06	Act - Snowberry - Rose	Typically on floodplains, lakeshores and in gullies where seepage is present. Dominated by cottonwood.	subhygric-mesic
07	Act - Dogwood	Cottonwood forest on floodplains.	subhygric - mesic
81	Bluebunch wheatgrass-Sandberg's bluegrass	Zonal grasslands on mid to lower slopes and level areas on morainal materials.	mesic - submesic
82	Rabbitbrush-Bluebunch wheatgrass-Selaginella	Very dry grassland on middle to upper slopes and crests on deep morainal, colluvial or glaciofluvial materials	xeric
83	Rough fescue	Grasslands dominated by rough fescue, on mid to lower slopes and level sites.	mesic - submesic

Map Symbol	Name	Description	Moisture Regime
84	Giant wildrye - Kentucky bluegrass	Moist grasslands on toe slopes, level areas and depressions.	subhygric-hygric
Ro01	Bluebunch wheatgrass - Sidewalk moss	Bedrock outcrops on steep upper slopes and crests; sparse vegetation.	very xeric - xeric
Ro02	Bluebunch wheatgrass - Selaginella	Shallow soils over bedrock, crests and upper slopes. Sparse shrub layer, sparse to abundant herb layer dominated by compact Selaginella.	very xeric - xeric
IDFxh2			
01	Fd -Pinegrass -Feathermoss	gentle middle to lower slopes and level areas.	mesic - submesic
02	FdPy -Selaginella -Bluebunch wheatgrass	forested rock outcrop on steep to gentle middle and upper slopes and crests	xeric - very xeric
03	FdPy -Bluebunch wheatgrass -Balsamroot	typically steep warm or gentle middle and upper slopes.	subxeric - xeric
04	FdPy -Rough fescue -Bluebunch wheatgrass	steep cool or gentle middle and upper slopes.	subxeric - mesic
05	FdPy -Bluebunch wheatgrass -Pinegrass	typically steep cool or gentle middle slopes.	submesic
06	Fd -Feathermoss	steep, cool or gentle middle or lower slopes	mesic - submesic
07	Fd -Snowberry -Pinegrass	Fd forest on gentle slopes and level areas.	mesic - subhygric

Map Symbol	Name	Description	Moisture Regime
08	$At -Rose -Pinegrass	aspen forests on gentle lower and toe slopes adjacent to grasslands	mesic - subhygric
09	SxwFd -Dogwood -Snowberry	moist gentle lower and toe slopes, depressions and level sites.	subhygric - hygric
10	$At -Snowberry -Rose	aspen forests on lower slopes, depressions and level areas.	subhygric
11	SxwEp -Hairbent grass	Sxw and birch forest on lower slopes, level areas and depressions on moist fluvial materials.	subhygric - hygric
12	Sxw-Horsetails	Sxw unit on level areas and depressions where the water table is near the soil surface	hygric - subhydric
52	Water birch -Northern bedstraw	Water birch-dominated riparian forest	hygric - subhygric
72	Juniper -Sidewalk moss	steep talus slopes	very xeric - xeric
73	Selaginella -Clad lichens	Rock outcrops on crest positions, shallow soils.	very xeric - xeric
81	Rough fescue	grasslands on level to gentle slopes on morainal materials	mesic - submesic
82	Bluebunch wheatgrass - Sandberg's bluegrass	grasslands on steep to gentle slopes, often warm aspects.	subxeric - submesic
83	Rough fescue -Bluebunch wheatgrass	grasslands on mid to upper slopes or level sites.	submesic - mesic
PPxh2			

Map Symbol	Name	Description	Moisture Regime
01	Py -Bluebunch wheatgrass -Rough fescue	PyFd forest on level to gentle slopes on morainal or colluvial materials	mesic to submesic
02	PyFd -Selaginella -Clad lichens	very dry Py Fd forest on crests and upper slopes, shallow soils	xeric to very xeric
03	Py -Red three-awn	Py forest on crests to mid slopes, coarse soils	xeric
04	Py -Bluebunch wheatgrass -Junegrass	PyFd forest on gentle to steep slopes	submesic - subxeric
06	Fd -Pinegrass -Feathermoss	Fd forest on mid to lower slopes and gullies	mesic - subhygric
07	ActFd -Dogwood -Douglas maple	mixed forest on gentle slopes and gullies, fluvial parent materials	subhygric
82	Bluebunch wheatgrass - Sandberg's bluegrass	Grasslands on steep, warm upper to mid slopes	subxeric - submesic
83	Rough fescue -Bluebunch wheatgrass	grasslands on middle and upper slopes	submesic-mesic
84	Rough fescue	grasslands on level to mid slopes on cool aspects	mesic to submesic
Fl30	Water birch -Dogwood	shrubby riparian forest on fluvial materials	mesic - submesic
Ro01	Bluebunch wheatgrass - Sidewalk moss	Bedrock outcrops on steep upper slopes and crests; sparse vegetation.	very xeric - xeric

Map Symbol	Name	Description	Moisture Regime
Ro02	Bluebunch wheatgrass - Selaginella	Shallow soils over bedrock, crests and upper slopes. Sparse shrub layer, sparse to abundant herb layer dominated by compact selaginella.	very xeric - xeric
Rt01	Saskatoon -Bluebunch wheatgrass	shrubby talus on steep middle to lower slopes	very xeric - xeric

Wetland Units

Map Symbol	Name	Description
Wm01	Beaked sedge - Water sedge	Sedge marsh found near ponds, along lake edges and floodplains.
Wm05	Cattail marsh	Cattail-dominated marsh found in depressions and along lakeshores and pond edges.
Wm06	Great bulrush marsh	Great bulrush-dominated marsh found along lake margins and in grassland depressions
Wm07	Baltic rush saline marsh	Saline marsh dominated by Baltic rush; occurs in small depressions that are flooded in spring and dry out by fall.
Ws03	Bebb's willow-Bluejoint	Willow swamp on pond margins and creek banks; shallow water early in season draws down to moist conditions later in the year

Ws04	Drummond's willow-Beaked sedge	Willow swamp with peat veneer over fluvial or lacustrine soils; often in association with low-gradient creeks
Gs01	Alkali Saltgrass herbaceous meadow	Saline meadow found on toe slopes, depressions and level areas adjacent to lakes and ponds.
Gs02	Nuttall's alkaligrass-Foxtail barley	Saline meadows associated with small alkaline potholes and lakes

7. SITE MODIFIERS

a	active floodplain
c	coarse-textured soils
f	fine-textured soils
g	gullying occurring, or in a gully bottom
h	hummocky terrain
j	gentle to moderate slope, <25% slope
k	cool aspect (285-135 deg.), 25-100% slope
m	medium-textured soils
n	glaciofluvial or colluvial fan/cone
r	ridge
s	shallow soils (20-100 cm to bedrock)
t	terrace
v	very shallow soils (<20cm to bedrock)
w	warm aspect slope (135 to 285 deg.; slope 25-100%)

8. ANTHROPOGENIC, SPARSELY VEGETATED OR NON-VEGETATED SITES

Map Symbol	Name	Description
AK	Alkaline Lake	A body of fresh water with a pH greater than 7 and a depth less than 2 m.
CB	Cutbank	A part of a road corridor or river course situated upslope of the road or river, which is created by excavation and/or erosion of the hillside.

Map Symbol	Name	Description
CF	Cultivated field	A flat or gently rolling, non-forested, open area that is subject to human agricultural practices (including plowing, fertilization and non-native crop production) which often result in long-term soil and vegetation changes.
ES	Exposed Soil	Any area of exposed soil such as areas of recent disturbance where vegetation cover is limited.
GP	Gravel Pit	An area exposed through the removal of sand and gravel.
LA	Lake	A naturally occurring static body of water, greater than 2 m deep in some portion. The boundary for the lake is the natural high water mark.
MI	Mine	An unvegetated area used for the extraction of mineral ore and other materials.
OW	Shallow open water	A wetland composed of permanent shallow open water and lacking extensive emergent plant cover. The water is less than 2 m deep.
PD	Pond	A small body of water greater than 2 m deep, but not large enough to be classified as a lake (e.g., less than 50 ha).
MZ	Rubbly mine spoils	Discarded overburden or waste rock moved so that ore can be extracted in a mining operation.
RW	Rural	Any area in which residences and other human developments are scattered and intermingled with forest, range, farm land, and native vegetation or cultivated crops.
RY	Reclaimed Mine	A mined area that has plant communities composed of a mixture of agronomic or native grasses, forbs, and shrubs.
RZ	Road surface	An area cleared and compacted for the purpose of transporting goods and services by vehicles.
UR	Urban	An area in which residences and other human developments form an almost continuous covering of the landscape

9. STRUCTURAL STAGE

1	Sparse/bryoid (< 20 yrs since major disturbance unless disclimax ecosystem)
2	Herb (< 20 yrs old unless disclimax)
2a	Forb-dominated (dominated by non-graminoid herbs)
2b	Graminoid-dominated (dominated by grasses, sedges, reeds and rushes)
3	Shrub (shrubs <10 m tall, < 20 yrs old for forested sites)
3a	Low Shrub (shrubs < 2 m tall)
3b	Tall Shrub (shrubs 2-10 m tall)
4	Pole /Sapling (trees > 10 m tall & usually < 40 yrs old)
5	Young Forest (trees > 10 m tall & 40-80 yrs old)
6	Mature Forest (trees > 10 m tall; 80-140 yrs old)
7	Old Forest (trees > 10 m tall; >140 yrs old)

10.DATA SOURCES

Aerial Photographs (colour, 2000) at 1:15,000: 30BCC00009 #35-41, 70-77, 135-139; 30BCC00052 #87-91, 93-97; 30BCC00051 #68-70, 194-199; 30BCC00010 #5-8, 69-72, 75-76; 30BCC00022#28-33, 100-103.

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11. CREDITS

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APPENDIX 3 TEM SUMMARIES

Table 1. LSA Area Breakdown by BEC Subzone and Ecosystem.

Biogeoclimatic subzone variant	Name	Site Series Number	Map Code	Structural Stage	Area (ha)
BGxw1	Alkaline pond	00	AK	(blank)	3.7
	Cutbank	00	CB	1	0.6
	Cultivated field	00	CF	2	67.3
	Exposed soil	00	ES	1	3.6
	Mine	00	MI	1	139.4
	Open water	00	OW	(blank)	5.3
	Pond	00	PD	(blank)	10.2
	Reclaimed mine	00	RY	2	10.4
	Road	00	RZ	(blank)	28.9
	Fd - Bluebunch wheatgrass - Rough fescue	03		4	5.4
	Fd- Snowberry - Step moss	04		3	0.4
				4	2.0
	At- Snowberry - Kentucky bluegrass	05		3	7.4
				4	4.3
	Act - Snowberry - Rose	06		4	2.4
	Act - Dogwood	07		3	2.0
	Bluebunch wheatgrass-Sandberg's bluegrass	81		2	324.2
				3	47.3
	Rabbitbrush-Bluebunch wheatgrass-Selaginella	82		2	1.6
	Rough fescue	83		2	38.9
				3	1.5
	Giant wildrye - Kentucky bluegrass	84		2	12.7
		Gs01		2	5.6
		Ro02		1	0.0
		Wm01		2	0.9
		Wm05		2	8.0
BG Total					**734.0**
IDF xh2	Alkaline pond	00	AK	(blank)	7.7
	Cultivated field	00	CF	2	172.7
	Gravel pit	00	GP	1	3.7
	Lake	00	LA	(blank)	73.0

Biogeoclimatic subzone variant	Name	Site Series Number	Map Code	Structural Stage	Area (ha)
	Mine	00	MI	1	19.4
	Mine spoils	00	MZ	1	25.6
	Open water	00	OW	(blank)	15.1
	Pond	00	PD	(blank)	13.8
	Rural	00	RW	(blank)	10.2
	Reclaimed mine	00	RY	2	114.3
	Road	00	RZ	(blank)	59.4
	Fd -Pinegrass -Feathermoss	01		3	26.4
				4	228.4
				5	294.1
				6	140.6
				7	9.7
	FdPy -Selaginella -Bluebunch wheatgrass	02		3	7.3
				4	8.1
				5	37.5
				6	17.9
	FdPy -Bluebunch wheatgrass -Balsamroot	03		3	40.4
				4	58.1
				5	93.4
				6	22.3
				7	7.2
	FdPy -Rough fescue -Bluebunch wheatgrass	04		3	2.5
				4	15.7
				5	34.4
				6	24.6
				7	2.2
	FdPy -Bluebunch wheatgrass -Pinegrass	05		5	8.8
	Fd -Feathermoss	06		3	8.5
				4	34.1
				5	24.8
				6	14.7
				7	0.7
	Fd -Snowberry -Pinegrass	07		3	22.7
				4	20.0
				5	23.1
				6	2.8

Biogeoclimatic subzone variant	Name	Site Series Number	Map Code	Structural Stage	Area (ha)
	$At -Rose -Pinegrass	08		4	5.8
				5	2.2
				6	0.6
	SxwFd -Dogwood -Snowberry	09		4	2.4
				5	12.6
				6	9.4
	$At -Snowberry -Rose	10		3	47.7
				4	27.8
				5	17.1
				6	0.7
	SxwEp -Hairbent grass	11		6	0.2
		12		5	3.0
	Water birch -Northern bedstraw	52		3	1.0
				4	6.3
				5	1.8
	Selaginella -Clad lichens	73		1	62.9
				2	1.3
	Rough fescue	81		2	417.0
				3	28.3
	Bluebunch wheatgrass -Sandberg's bluegrass	82		2	727.7
				3	117.2
	Rough fescue -Bluebunch wheatgrass	83		2	1490.7
				3	3.8
	Alkali Saltgrass herbaceous meadow	Gs01		2	2.6
	Nuttall's alkaligrass-Foxtail barley	Gs02		2	9.9
	Beaked sedge -Water sedge	Wm01		2	7.4
	Cattail marsh	Wm05		2	12.2
	Great bulrush marsh	Wm06		2	10.9
	Baltic rush saline marsh	Wm07		2	7.7
	Bebb's willow-Bluejoint	Ws03		2	9.0
				3	7.0
	Drummond's willow-Beaked sedge	Ws04		3	2.5
IDFxh2 Total					**4802.1**

Biogeoclimatic subzone variant	Name	Site Series Number	Map Code	Structural Stage	Area (ha)
PPxh2	Alkaline pond	00	AK	(blank)	5.2
	Cutbank	00	CB	1	0.7
	Cultivated field	00	CF	2	2.1
	Reclaimed mine	00	RY	2	5.3
	Road	00	RZ	(blank)	11.3
	Py -Bluebunch wheatgrass -Rough fescue	01		3	47.1
				4	109.7
				5	38.5
				6	1.0
	PyFd -Selaginella -Clad lichens	02		3	2.4
	Py -Bluebunch wheatgrass -Junegrass	04		3	19.1
				4	23.9
				5	12.1
	Fd -Pinegrass -Feathermoss	06		3	1.3
				4	12.1
	Bluebunch wheatgrass -Sandberg's bluegrass	82		2	63.9
	Rough fescue -Bluebunch wheatgrass	83		2	18.1
				3	24.2
	Rough fescue	84		2	5.2
	Alkali Saltgrass herbaceous meadow	Gs01		2	3.1
	Bluebunch wheatgrass -Selaginella	Ro02		1	0.9
PPx2 Total					**407.4**
Grand Total					**5943.6**

Table 2. Structural Stage Breakdown of the TEM Portion of the LSA.

Biogeoclimatic Subzone Variant	Structural Stage*	**Total** Mapped in LSA (ha)
BGxw1	1	143.6
	2	469.4
	3	58.7
	4	14.2
	(blank)	48.1
BG Total		**734.0**
IDFxh2	1	111.6
	2	2983.4
	3	315.1
	4	406.6
	5	552.8
	6	233.8
	7	19.8
	(blank)	179.1
IDF Total		**4,802.1**
PPxh2	1	1.6
	2	97.8
	3	94.1
	4	145.8
	5	50.6
	6	1.0
	(blank)	16.5
PP Total		**407.4**
LSA Total		**5,943.6**

*waterbodies, roads and urban areas have no structural stage

Table 3. Subzone Variants in the Portion of the LSA Not Within the TEM.

Subzone Variant	Ha in LSA Outside of TEM
BGxh2	8.3
BGxw1	437.9
IDFxh2	332.0
PPxh2	334.3
TOTAL	1,112.4

APPENDIX 4 RARE PLANTS AND LICHENS POTENTIALLY OCCURRING IN THE LSA BASED ON BIOGEOCLIMATIC VARIANT (BC CONSERVATION DATA CENTRE 2014) AND PROFESSIONAL JUDGEMENT

Taxon	Common Name	BC List*	SARA+	COSEWIC++
VASCULAR PLANTS				
Achnatherum thurberianum	Thurber's Needlegrass	Red		
Acorus americanus	American Sweet-flag	Blue		
Agastache urticifolia	Nettle-leaved Giant-hyssop	Blue		
Allium geyeri var. *tenerum*	Geyer's Onion	Blue		
Alopecurus carolinianus	Carolina Meadow-foxtail	Red		
Ammannia robusta	Scarlet Ammannia	Red	1-E	E
Amsinckia retrorsa	Rough Fiddleneck	Red		
Antennaria flagellaris	Stoloniferous Pussytoes	Red	1-E	E
Astragalus sclerocarpus	The Dalles Milk-vetch	Red		
Astragalus spaldingii	Spalding's Milk-vetch	Red		
Atriplex argentea ssp. *argentea*	Silvery Orache	Red		
Atriplex truncata	Wedgescale Orache	Blue		
Azolla mexicana	Mexican Mosquito Fern	Red	1-T	T
Berula erecta	Cut-leaved Water-parsnip	Blue		
Bidens vulgata	Tall Beggarticks	Red		
Boechera sparsiflora	Stretching Suncress	Red		
Bolboschoenus fluviatilis	River Bulrush	Red		
Botrychium simplex var. *compositum*	Least Moonwort	Blue		
Bouteloua gracilis	Blue Grama	Red		
Brickellia oblongifolia ssp. *oblongifolia*	Narrow-leaved Brickellia	Blue		
Calochortus lyallii	Lyall's Mariposa Lily	Blue	1-T	SC
Carex comosa	Bearded Sedge	Red		
Carex heleonastes	Hudson Bay Sedge	Blue		
Carex hystericina	Porcupine Sedge	Blue		
Carex lenticularis	Lakeshore Sedge	Blue		
Carex pedunculata	Peduncled Sedge	Blue		
Carex sychnocephala	Many-headed Sedge	Blue		
Carex vallicola var. *vallicola*	Valley Sedge	Red		
Carex vulpinoidea	Fox Sedge	Blue		
Castilleja cusickii	Cusick's Paintbrush	Red		
Castilleja minor ssp. *minor*	Annual Paintbrush	Red		
Chamaerhodos erecta ssp. *nuttallii*	American Chamaerhodos	Blue		
Chamaesyce serpyllifolia ssp. *serpyllifolia*	Thyme-leaved Spurge	Blue		
Chenopodium atrovirens	Dark Lamb's-quarters	Red		

Taxon	Common Name	BC List*	SARA+	COSEWIC++
Collomia tenella	Slender Collomia	Red	1-E	E
Crepis modocensis ssp. *modocensis*	Low Hawksbeard	Red		
Crepis modocensis ssp. *rostrata*	Western Low Hawksbeard	Red		
Crepis occidentalis ssp. *pumila*	Gray Hawk's-beard	Red		
Cryptantha ambigua	Obscure Cryptantha	Blue		
Cryptantha celosioides	Cockscomb Cryptantha	Red		
Cryptantha watsonii	Watson's Cryptantha	Red		
Cuscuta campestris	Field Dodder	Blue		
Cyperus erythrorhizos	Red-rooted Cyperus	Red		
Cyperus squarrosus	Awned Cyperus	Blue		
Delphinium bicolor ssp. *bicolor*	Montana Larkspur	Blue		
Descurainia sophioides	Northern Tansymustard	Red		
Dicentra uniflora	Steer's Head	Blue		
Drymocallis arguta	Tall Cinquefoil	Red		
Dryopteris cristata	Crested Wood Fern	Blue		
Elatine rubella	Three-flowered Waterwort	Blue		
Eleocharis atropurpurea	Purple Spike-rush	Red		E
Eleocharis coloradoensis	Dwarf Spike-rush	Red		
Eleocharis elliptica	Elliptic Spike-rush	Blue		
Eleocharis engelmannii	Englemann's Spike-rush	Red		
Eleocharis geniculata	Bent Spike-rush	Red	1-E	E
Eleocharis ovata	Ovate Spike-rush	Red		
Eleocharis rostellata	Beaked Spike-rush	Blue		
Elodea nuttallii	Nuttall's Waterweed	Blue		
Epilobium halleanum	Hall's Willowherb	Blue		
Epilobium oregonense	Oregon Willowherb	Blue		
Epilobium pygmaeum	Smooth Spike-primrose	Red		
Epipactis gigantea	Giant Helleborine	Blue		SC
Erigeron leibergii	Leiberg's Fleabane	Red		
Erigeron poliospermus var. *poliospermus*	Cushion Fleabane	Blue		
Eriogonum strictum var. *proliferum*	Strict Buckwheat	Red		
Floerkea proserpinacoides	False-mermaid	Blue		NAR
Gaura coccinea	Scarlet Gaura	Red		
Gayophytum humile	Dwarf Groundsmoke	Blue		
Gayophytum racemosum	Racemed Groundsmoke	Red		
Gayophytum ramosissimum	Hairstem Groundsmoke	Red		
Gentiana affinis	Prairie Gentian	Blue		
Gilia sinuata	Shy Gilia	Red		
Glyceria pulchella	Slender Mannagrass	Blue		
Hedeoma hispida	Mock-pennyroyal	Red		
Hemizonella minima	Small-headed Tarweed	Red		
Hesperostipa spartea	Porcupinegrass	Red		
Heterocodon rariflorum	Heterocodon	Blue		

Taxon	Common Name	BC List*	SARA+	COSEWIC++
Hornungia procumbens	Ovalpurse	Blue		
Impatiens aurella	Orange Touch-me-not	Blue		
Iva axillaris	Poverty-weed	Red		
Juncus confusus	Colorado Rush	Red		
Lappula occidentalis var. *cupulata*	Western Stickseed	Red		
Lathrocasis tenerrima	Slender Gilia	Red		
Leptosiphon harknessii	Harkness' Linanthus	Red		
Leptosiphon septentrionalis	Northern Linanthus	Blue		
Lewisia columbiana var. *columbiana*	Columbia Lewisia	Blue		
Lewisia triphylla	Three-leaved Lewisia	Blue		
Limosella acaulis	Owyhee Mudwort	Red		
Lindernia dubia var. *anagallidea*	False-pimpernel	Blue		
Lindernia dubia var. *dubia*	Yellowseed False Pimpernel	Red		
Lipocarpha micrantha	Small-flowered Lipocarpha	Red	1-E	E
Lomatium brandegeei	Brandegee's Lomatium	Blue		
Lomatium triternatum ssp. *platycarpum*	Nine-leaved Desert-parsley	Red		
Lupinus argenteus var. *laxiflorus*	Silvery Lupine	Red		
Lupinus bingenensis var. *subsaccatus*	Suksdorf's Lupine	Red		
Marsilea vestita	Hairy Water-clover	Red		
Melica bulbosa	Oniongrass	Blue		
Melica spectabilis	Purple Oniongrass	Blue		
Micranthes idahoensis	Idaho Saxifrage	Red		
Mimulus breviflorus	Short-flowered Monkey-flower	Blue		
Mimulus breweri	Brewer's Monkey-flower	Blue		
Muhlenbergia racemosa	Satin Grass	Red		
Myriophyllum ussuriense	Ussurian Water-milfoil	Blue		
Navarretia intertexta	Needle-leaved Navarretia	Red		
Navarretia propinqua	Near Navarretia	Red		
Neoholmgrenia andina	Andean Evening-primrose	Red		
Nicotiana attenuata	Wild Tobacco	Red		
Oenothera pallida ssp. *pallida*	Pale Evening-primrose	Red		
Olsynium douglasii var. *inflatum*	Satinflower	Red		
Opuntia x columbiana	Grizzlybear Prickly Pear	Blue		
Orobanche corymbosa ssp. *mutabilis*	Flat-topped Broomrape	Blue		
Orobanche ludoviciana var. *arenosa*	Suksdorf's Broomrape	Red		
Orthocarpus barbatus	Grand Coulee Owl-clover	Red	1-E	E
Pectocarya penicillata	Winged Combseed	Red		
Phacelia ramosissima var. *ramosissima*	Branched Phacelia	Red	1-E	E
Phlox speciosa ssp. occidentalis	Showy Phlox	Red	1-T	T
Physaria didymocarpa ssp. *didymocarpa*	Common Twinpod	Blue		

Taxon	Common Name	BC List*	SARA+	COSEWIC++
Plagiobothrys leptocladus	Finebranched Popcornflower	Red		
Poa fendleriana ssp. fendleriana	Mutton Grass	Red		
Polygonum engelmannii	Engelmann's Knotweed	Blue		
Polygonum polygaloides ssp. *kelloggii*	Kellogg's Knotweed	Blue		
Polystichum scopulinum	Mountain Holly Fern	Red	1-T	T
Potamogeton nodosus	Long-leaved Pondweed	Red		
Potamogeton perfoliatus	Perfoliate Pondweed	Blue		
Potentilla paradoxa	Bushy Cinquefoil	Red		
Psilocarphus brevissimus var. *brevissimus*	Dwarf Woolly-heads	Red	1-E	E
Pyrola elliptica	Shinleaf Wintergreen	Blue		
Ranunculus pedatifidus ssp. *affinis*	Birdfoot Buttercup	Blue		
Ribes oxyacanthoides ssp. *cognatum*	Northern Gooseberry	Red		
Rotala ramosior	Toothcup Meadow-foam	Red	1-E	E
Salix amygdaloides	Peach-leaf Willow	Red		
Salix boothii	Booth's Willow	Blue		
Sandbergia whitedii	Whited's Halimolobos	Blue		
Schoenoplectus americanus	Olney's Bulrush	Red		
Schoenoplectus saximontanus	Rocky Mountain Clubrush	Red		
Senecio integerrimus var. *ochroleucus*	White Western Groundsel	Red		
Sidalcea oregana var. *procera*	Oregon Checker-mallow	Red		
Silene drummondii var. *drummondii*	Drummond's Campion	Blue		
Sparganium fluctuans	Water Bur-reed	Blue		
Sphaeralcea coccinea	Scarlet Globe-mallow	Red		
Sphaeralcea munroana	Munroe's Globe-mallow	Red		
Sphenopholis obtusata	Prairie Wedgegrass	Red		
Spiranthes diluvialis	Ute lady's tresses	Red		
Sporobolus airoides	Hairgrass Dropseed	Blue		
Sporobolus compositus var. *compositus*	Rough Dropseed	Blue		
Stellaria obtusa	Blunt-sepaled Starwort	Blue		
Stuckenia vaginata	Sheathing Pondweed	Blue		
Symphyotrichum frondosum	Short-rayed Aster	Red	1-E	E
Taraxia breviflora	Short-flowered Evening-primrose	Red		
Thelypodium laciniatum var. *laciniatum*	Thick-leaved Thelypody	Blue		
Trifolium cyathiferum	Cup Clover	Red		
Triglochin debilis	Slender Arrow-grass	Red		
Verbena hastata var. *scabra*	Blue Vervain	Blue		
Viola septentrionalis	Northern Violet	Red		
MOSSES				
Zeltnera exaltata	Western Centaury	Red		

Taxon	Common Name	BC List*	SARA+	COSEWIC++
Aloina brevirostris	[no common name]	Blue		
Bryoerythrophyllum columbianum	Columbian Carpet Moss	Blue	1-SC	SC
Coscinodon cribrosus	[no common name]	Red		
Crossidium seriatum	[no common name]	Blue		C
Didymodon brachyphyllus	[no common name]	Red		
Encalypta spathulata	[no common name]	Blue		
Entosthodon rubiginosus	Rusty Cord-moss	Red	1-E	E
Funaria muhlenbergii	[no common name]	Blue		
Grimmia plagiopodia	[no common name]	Red		
Hilpertia velenovskyi	[no common name]	Red		
Microbryum vlassovii	Nugget Moss	Red	1-E	E
Mnium arizonicum	[no common name]	Blue		
Orthotrichum cupulatum	[no common name]	Blue		
Orthotrichum hallii	[no common name]	Red		
Plagiobryum demissum	[no common name]	Red		
Pterygoneurum kozlovii	Alkaline Wing-nerved Moss	Blue	1-T	T
Pterygoneurum lamellatum	[no common name]	Red		
Ptychomitrium gardneri	[no common name]	Blue		
Schistidium heterophyllum	[no common name]	Blue		
Stegonia latifolia var. *pilifera*	[no common name]	Red		
Tortula cernua	[no common name]	Blue		
Tortula obtusifolia	[no common name]	Blue		
Tortula protobryoides	[no common name]	Red		
Ulota curvifolia	[no common name]	Blue		
Weissia brachycarpa	[no common name]	Red		
LICHENS				
Agrestia hispida	Desert vagabond	Red		
Cladonia luteoalba	Lemon pixie	Blue		
Collema crispum	Ten-cent tarpaper	Red		
Collema cristatum var. *marginale*	Fingered tarpaper	Red		
Collema polycarpon	Gilled tarpaper	Red		
Dermatocarpon leptophyllodes	Jigsaw stippleback	Blue		
Hypogymnia recurva	Recoiling bone	Red		
Leptogium intermedium	Fourty-five vinyl	Blue		
Leptogium schraderi	Collapsing vinyl	Red		
Leptogium tenuissimum	Birdnest vinyl	Red		
Neofuscelia loxodes	Blistered toad	Blue		
Neofuscelia subhosseana	Erupting toad	Blue		
Neofuscelia verruculifera	Carbuncular toad	Red		
Peltula euploca	Powder-lined rock-olive	Red		
Phaeophyscia adiastola	Granulating shadow	Red		
Phaeophyscia ciliata	Greater eye shadow	Blue		
Phaeophyscia hirsuta	Smiling shadow	Red		
Phaeophyscia hispidula	Whiskered shadow	Red		

Taxon	Common Name	BC List*	SARA+	COSEWIC++
Phaeophyscia kairamoi	Five o'clock shadow	Blue		
Phaeophyscia nigricans	Least shadow	Red		
Physcia biziana	Frosted rosette	Blue		
Physcia dimidiata	Exuberant rosette	Red		
Physcia dubia	Grinning rosette	Blue		
Physcia tribacia	Beaded rosette	Red		
Physciella chloantha	Downside shade	Blue		
Rhizoplaca peltata	Brown-eyed rockbright	Blue		
Squamarina lentigera	Snow-white dimple	Red		
Synalissa symphorea	Eyed rockgorgon	Blue		
Thallinocarpon nigritellum	Black rocklicorice	Blue		
Umbilicaria hirsuta	Granulating rocktripe	Red		
Vahliella californica	Sun snaps	Red		

* **BC List** (BCMOE 2014):

- **Red List**: Includes any ecological community, and indigenous species and subspecies that is extirpated, endangered, or threatened in British Columbia. Extirpated elements no longer exist in the wild in British Columbia, but do occur elsewhere. Endangered elements are facing imminent extirpation or extinction. Threatened elements are likely to become endangered if limiting factors are not reversed. Red-listed species and sub-species may be legally designated as, or may be considered candidates for legal designation as Extirpated, Endangered or Threatened under the Wildlife Act. Not all Red-listed taxa will necessarily become formally designated. Placing taxa on these lists flags them as being at risk and requiring investigation.
- **Blue List**: Includes any ecological community, and indigenous species and subspecies considered to be of special concern (formerly vulnerable) in British Columbia. Elements are of special concern because of characteristics that make them particularly sensitive to human activities or natural events. Blue-listed elements are at risk, but are not Extirpated, Endangered or Threatened.

+SARA – Species at Risk Act (Government of Canada 2002):

- **1-E**: Schedule 1 Endangered – the species is "…facing imminent extirpation or extinction"
- **1-T**: Schedule 1 Threatened – the species is "…likely to become an endangered species if nothing is done to reverse the factors leading to its extirpation or extinction"
- **1-SC**: Special Concern – the species "…may become threatened or endangered because of a combination of biological characteristics and identified threats"

++COSEWIC – Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2011):

- **E**: Endangered – the species is "…facing imminent extirpation or extinction."
- **T**: Threatened – the species is "…likely to become an endangered species if nothing is done to reverse the factors leading to its extirpation or extinction."
- **SC**: Special Concern – the species "…may become threatened or endangered because of a combination of biological characteristics and identified threats."

- **NAR**: Not at Risk – the species "…has been evaluated and found to be not at risk of extinction given the current circumstances."

APPENDIX 5 ECOLOGICAL COMMUNITIES AT RISK AND THEIR ASSOCIATED SITE SERIES

Units from the old Kamloops field guide as listed by the CDC (in brackets; BC CDC 2014), and the draft Kamloops field guide (Lloyd et al. 2005)

Scientific Name	English Name	BC List	Identified Wildlife	BGxh2	BGxw1	IDFxh2	PPxh2
Artemisia tridentata / Pseudoroegneria spicata	big sagebrush / bluebunch wheatgrass	Red		(01)81	(04) 81ls		(05)83ls
Betula occidentalis / Rosa spp.	water birch / roses	Red	Y				Fl07
Carex atherodes Fen - Marsh	awned sedge Fen - Marsh	Red			Wm03		
Equisetum fluviatile - Carex utriculata	swamp horsetail - beaked sedge	Blue		Wm02			
Festuca campestris - Pseudoroegneria spicata	rough fescue - bluebunch wheatgrass	Red		(06) 87	(06) 83ls	(91) 83	
Juncus balticus - Carex praegracilis	Baltic rush - field sedge	Blue		Gs03	Gs03		Gs03
Juncus balticus - Potentilla anserina	Baltic rush - common silverweed	Red			Wm07		
Leymus cinereus Herbaceous Vegetation	giant wildrye Herbaceous Vegetation	Red			(07) 84		
Pinus ponderosa / Pseudoroegneria spicata	ponderosa pine / bluebunch wheatgrass	Blue		(04)	(03) 02		(03, 04)04
Pinus ponderosa / Pseudoroegneria spicata - Festuca campestris	ponderosa pine / bluebunch wheatgrass - rough fescue	Blue			(05)??		(01) 01

Scientific Name	English Name	BC List	Identified Wildlife	BGxh2	BGxw1	IDFxh2	PPxh2
Populus balsamifera ssp. *trichocarpa - Betula occidentalis*	black cottonwood - water birch	Red					(07)??
Populus balsamifera ssp. trichocarpa / Symphoricarpos albus - Rosa spp.	black cottonwood / common snowberry - roses	Red		Fm01	Fm01		
Populus tremuloides / Symphoricarpos albus / Poa pratensis	trembling aspen / common snowberry / Kentucky bluegrass	Red			(08) 05	(95) 10YS	
Pseudoroegneria spicata - Koeleria macrantha	bluebunch wheatgrass - junegrass	Red			(01) 83esa	(92) 83	
Pseudotsuga menziesii - Pinus ponderosa / Calamagrostis rubescens	Douglas-fir - ponderosa pine / pinegrass	Blue				(01, 05) ??	
Pseudotsuga menziesii - Pinus ponderosa / Pseudoroegneria spicata	Douglas-fir - ponderosa pine / bluebunch wheatgrass	Red				(02, 03) 03	
Pseudotsuga menziesii - Pinus ponderosa / Pseudoroegneria spicata - Calamagrostis rubescens	Douglas-fir - ponderosa pine / bluebunch wheatgrass - pinegrass	Blue				(04) 05	
Pseudotsuga menziesii / Symphoricarpos albus - Amelanchier alnifolia	Douglas-fir / common snowberry - saskatoon	Red					(06)??
Salix bebbiana / Calamagrostis canadensis	Bebb's willow / bluejoint reedgrass	Blue			Ws03		
Salix exigua Shrubland	narrow-leaf willow Shrubland	Red			Fl06		

Scientific Name	English Name	BC List	Identified Wildlife	BGxh2	BGxw1	IDFxh2	PPxh2
Thuja plicata - Pseudotsuga menziesii / Cornus stolonifera	western redcedar - Douglas-fir / red-osier dogwood	Blue				(07)	
Typha latifolia Marsh	common cattail Marsh	Blue		Wm05	Wm05	Wm05	Wm05

APPENDIX 6 TERRESTRIAL WILDLIFE TAXA CONSIDERED AS POTENTIAL INDICATORS

Scientific Name	Common Name	**SARA schedule	*BC List	Previous records in LSA?	Potentially Present in LSA?	Chosen as indicator?	Rationale
Satyrium californica	California Hairstreak		B	No	Possible	Yes/ Invertebrates	Species at risk; potentially suitable habitat present; potential for interaction with Project; known from Kamloops area
Pholisora catullus	Common Sooty Wing		B	No	Possible	Yes/ Invertebrates	Species at risk; potentially suitable habitat present; potential for interaction with Project
Enallagma hageni	Hagen's Bluet		B	No	Possible	No	Adequately covered by effects to Olive Clubtail
Magnipelta mycophaga	Magnum Mantleslug		B	No	Possible	No	Insufficient info available for assessment
Danaus plexippus	Monarch	1 SC	B	No	Possible	Yes/ Invertebrates	Species at risk; potentially suitable habitat present; potential for interaction with Project

Scientific Name	Common Name	**SARA schedule	*BC List	Previous records in LSA?	Potentially Present in LSA?	Chosen as indicator?	Rationale
Hesperia nevada	Nevada Skipper		B	No	Possible	Yes/ Invertebrates	Species at risk; potentially suitable habitat present; potential for interaction with Project
Stylurus olivaceus	Olive Clubtail		R	No	Possible	Yes/ Invertebrates	Species at risk; potentially suitable habitat present; potential for interaction with Project
Hemphillia camelus	Pale Jumping-slug		B	No	Possible	No	Insufficient info available for assessment
Vallonia cyclophorella	Silky Vallonia		B	No	Possible	No	Insufficient info available for assessment
Promenetus umbilicatellus	Umbilicate Sprite		B	No	Unknown	No	Insufficient info available for assessment
Rana luteiventris	Columbian spotted frog		Y	Yes	Yes	Yes/ Amphibians	Regional concern; confirmed in LSA; high potential for effects due to Project

Scientific Name	Common Name	**SARA schedule	*BC List	Previous records in LSA?	Potentially Present in LSA?	Chosen as indicator?	Rationale
Spea intermontana	Great Basin Spadefoot	1 T	B	Yes	Yes	Yes/ Amphibians	Species at risk; confirmed in LSA; high potential for effects due to Project
Pseudacris regilla	Northern Pacific treefrog		Y	Yes	Yes	Yes/ Amphibians	Regional concern; confirmed in LSA; high potential for effects due to Project
Anaxyrus boreas	Western Toad	1 SC	B	Yes	Yes	Yes/ Amphibians	Species at risk; known present; high potential for effects due to Project
Pituophis catenifer deserticola	Gophersnake, *deserticola* subspecies	1 T	B	Nearby - CDC; Rescan (anecdotal)	Possible	Yes/ Reptiles	Species at risk; Potentially suitable habitat present; historical anecdotal records from landowners; high potential for effects due to Project
Coluber constrictor	North American Racer	1 SC	B	Yes? – Rescan 2006 (anecdotal)	Possible	Yes/ Reptiles	Species at risk; Potentially suitable habitat present; high potential for effects due to Project

Scientific Name	Common Name	**SARA schedule	*BC List	Previous records in LSA?	Potentially Present in LSA?	Chosen as indicator?	Rationale
Charina bottae	Rubber Boa	1 SC	Y	Yes	Yes	Yes/ Reptiles	Species at risk; known present; high potential for effects due to Project
Chrysemys picta pop. 2	Western Painted Turtle	1 – SC	B	Anecdotal, but possible released individual (Rescan 2006)	Unlikely	No	Little suitable habitat present
Crotalus oreganus	Western Rattlesnake	1 T	B	No	Possible	Yes/ Reptiles	Species at risk; Potentially suitable habitat present; high potential for effects due to Project
Bonasa umbellus	Ruffed Grouse		Y	Yes	Yes	Yes/ Grouse	Known present; Aboriginal Groups concern; Potential for interaction with Project
Tympanuchus phasianellus columbianus	Sharp-tailed Grouse, *columbianus* subspecies		B	lek sites known	Yes	Yes/ Grouse	Known present; known lek sites; sensitive species; grasslands indicator; Aboriginal Groups concern

Scientific Name	Common Name	**SARA schedule	*BC List	Previous records in LSA?	Potentially Present in LSA?	Chosen as indicator?	Rationale
Recurvirostra americana	American Avocet		R	Afton tailings pond, 1989, 1993; 2 birds at Wallender Lake (1989)	Occasional	No	No recent records; no breeding known; likely only migrant use
Botaurus lentiginosus	American Bittern		B	No	Possible but unknown	Yes/ Migratory Birds	Species at risk; no surveys done; Potentially suitable habitat present; marsh bird group indicator
Dolichonyx oryzivorus	Bobolink		B	Nearby - CDC	Unlikely	No	No records near Project and not detected on bird surveys
Spizella breweri breweri	Brewer's Sparrow, *breweri* subspecies		R	No	Unlikely	No	Rarely detected in Kamloops area; breeding unconfirmed
Catherpes mexicanus	Canyon Wren		B	No	Unlikely	No	No previous records near Project and not detected on bird surveys

Scientific Name	Common Name	**SARA schedule	*BC List	Previous records in LSA?	Potentially Present in LSA?	Chosen as indicator?	Rationale
Hirundo rustica	Barn Swallow	1T	B	Yes – field surveys	Yes	Yes/ Migratory Birds	Species at risk; Confirmed in LSA; vulnerable to Project effects
Chordeiles minor	Common Nighthawk	1T	Y	Yes - field surveys	Yes	Yes/ Migratory Birds	Species at risk; Confirmed in LSA; high potential for effects due to Project
Ardea herodias herodias	Great Blue heron, *herodias* subspecies		B	Y – field surveys	Yes	Yes / Migratory Birds	Species at risk; occasional use of LSA; nesting colonies highly sensitive
Eremophila alpestris merrilli	Horned Lark *merillii* subspecies		B	unknown	Possible	No	Potentially suitable habitat present; effects can be assessed under Grasslands VC
Chondestes grammacus	Lark Sparrow		R	No	Possible	No	Potentially suitable habitat present; not detected on bird surveys; effects can be assessed under Grasslands VC

Scientific Name	Common Name	**SARA schedule	*BC List	Previous records in LSA?	Potentially Present in LSA?	Chosen as indicator?	Rationale
Melanerpes lewis	Lewis's Woodpecker	1 T	R	Ironmask Hill-CDC; detected 2008 (this study)	Yes	Yes/ Migratory Birds	Species at risk; suitable habitat present; confirmed in vicinity
Numenius americanus	Long-billed Curlew	1SC	B	No	Possible	Yes/ Migratory Birds	Species at risk; suitable habitat present; Agency concern
Contopus cooperi	Olive-sided Flycatcher	1 T	B	Yes	Yes	Yes/ Migratory Birds	Species at risk; Known present; forest bird indicator
Euphagus carolinus	Rusty Blackbird	1 SC	B	No	Possible	No	Very little suitable breeding habitat present
Grus canadensis	Sandhill Crane		Y	Yes	Yes	Yes/ Migratory Birds	Regional and public concern
Aechmophorus occidentalis	Western Grebe		R	No	No	No	Colonial nester, no colonies known in area
Sphyrapicus thyroideus thyroideus	Williamson's Sapsucker, *thyroideus* subspecies	1 E	R	Yes	Yes	Yes/ Migratory birds	Species at risk; Previous records; Potentially suitable habitat present

Scientific Name	Common Name	**SARA schedule	*BC List	Previous records in LSA?	Potentially Present in LSA?	Chosen as indicator?	Rationale
Athene cunicularia	Burrowing Owl	1 E	R	Nearby - CDC; Rescan 2006 (anecdotal)	Possible	Yes/ Raptors	Species at risk; suitable habitat present; high public concern
Haliaeetus leucocephalus	Bald Eagle		Y	Yes	Known present	Yes/Raptors	Known nests protected under Wildlife Act; public concern
Psiloscops flammeolus	Flammulated Owl	1 SC	B	Records from Cherry Creek area	Possible	Yes/ Raptors	Species at risk; nearby records; some potentially suitable habitat present
Strix nebulosa	Great Gray Owl		Y	Yes	Yes	Yes/ Raptors	Regional concern; known use of LSA
Falco peregrinus anatum	Peregrine Falcon, *anatum* subspecies	1 T	R	Detected 2008 (this study)	Yes	Yes/ Raptors	Species at risk; Possibly suitable nesting habitat on Sugarloaf cliffs
Falco mexicanus	Prairie Falcon		R	Unconfirmed detection 2007 (this study)	Possible	Yes/ Raptors	Species at risk; Potentially suitable habitat present on Sugarloaf cliffs

Scientific Name	Common Name	**SARA schedule	*BC List	Previous records in LSA?	Potentially Present in LSA?	Chosen as indicator?	Rationale
Buteo lagopus	Rough-legged Hawk		B	Yes	Yes	Yes/ Raptors	Species at risk; known winter use; regional concern
Buteo swainsoni	Swainson's Hawk		R	Yes	Yes	Yes/ Raptors	Species at risk; known nest sites; high potential for Project effects
Asio flammeus	Short-eared Owl	1 SC	B	Yes	Yes	Yes/ Raptors	Species at risk; known present
Megascops kennicottii macfarlanei	Western Screech-Owl, *macfarlanei* subspecies	1 E	R	No	No	No	Not known present in THB ecosection
Taxidea taxus	Badger	1 E	R	Yes – field surveys	Yes	Yes/ Mammals	Species at risk; Confirmed in LSA; vulnerable to Project effects
Castor canadensis	Beaver		Y	Yes	Yes	No	Widely distributed and adaptable species; local population regulated by trapping

Scientific Name	Common Name	**SARA schedule	*BC List	Previous records in LSA?	Potentially Present in LSA?	Chosen as indicator?	Rationale
Ovis canadensis	Bighorn Sheep		B	No	No	No	No suitable habitat present (large cliff areas)
Ursus americana	Black Bear		Y	Yes	Yes	No	Widely distributed and adaptable species
Puma concolor	Cougar		Y	Yes	Yes	No	Widely-distributed species; effects can be approximated by effects on prey (deer)
Pekania pennanti	Fisher		B	No	No	No	Little suitable habitat present
Myotis thysanodes	Fringed Myotis	3	B	No	Yes	Yes/ Mammals	Species at risk; known present
Perognathus parvus	Great Basin Pocket Mouse		R	No	Possible	Yes/ Mammals	Species at risk; Potentially suitable habitat present ; unsurveyed
Ursus arctos	Grizzly Bear		B	No	No	No	No suitable habitat
Myotis lucifugus	Little Brown Myotis		Y	Yes	Yes	Yes/ Mammals	Species at risk, known present

Scientific Name	Common Name	**SARA schedule	*BC List	Previous records in LSA?	Potentially Present in LSA?	Chosen as indicator?	Rationale
Alces americana	Moose		Y	Yes	Yes	Yes/ Mammals	Aboriginal Groups and public concern
Ondontra zibethicus	Muskrat		Y	Yes	Yes	No	Widely distributed and abundant species
Odocoileus hemionus	Mule deer		Y	Yes	Yes	Yes/ Mammals	Aboriginal Groups and public concern; designated winter range present
Erethizon dorsatum	Porcupine		Y	Yes	Yes	No	Very widely distributed across the province
Euderma maculatum	Spotted Bat	1 SC	B	No	Possible	Yes/ Mammals	Species at risk; Potentially suitable habitat present
Corynorhinus townsendii	Townsend's Big-eared Bat		B	No	Possible	Yes/ Mammals	Species at risk; Potentially suitable habitat present
Myotis ciliolabrum	Western Small-footed Myotis		B	No	Possible	Yes/ Mammals	Species at risk; known present
Gulo gulo luscus	Wolverine, *luscus* subspecies		B	No	No	No	No suitable habitat

Scientific Name	Common Name	**SARA schedule	*BC List	Previous records in LSA?	Potentially Present in LSA?	Chosen as indicator?	Rationale
Odocoileus virginianus	White-tailed deer		Y	Yes	Yes	No	Adequately covered by mule deer indicator

*R = Red list, B= Blue list, Y= Yellow list

**E=Endangered, T=Threatened, SC = Special Concern

Appendix 7 List of Vertebrate Wildlife Species Detected by Observation and/or by Sign During Project Field Surveys or by KGHM Staff, with their Provincial, COSEWIC, SARA and Conservation Framework Status.

Common Name	Scientific Name	COSEWIC status*	BC Status**	FN Concern	SARA Schedule*	Identified Wildlife?	Conservation Framework			
							Highest Priority	Goal 1	Goal 2	Goal 3
MAMMALS										
Moose	*Alces americanus*	-	Y	Y	none	No	6	6	6	6
Mule deer	*Odocoileus hemionus*	-	Y	Y	none	No	6	6	6	6
Coyote	*Canis latrans*	-	Y	Y	none	No	6	6	6	6
Black bear	*Ursus americana*	NAR	Y	Y	none	No	6	6	6	6
Red fox	*Vulpes vulpes*	-	Y	Y	none	No	6	6	6	6
Badger	*Taxidea taxus*	E	R	Y	1 – E	Yes	1	6	6	1
Cougar	*Puma concolor*	-	Y	Y	none	No	4	4	6	5
Bushy-tailed woodrat	*Neotoma cinereus*	-	Y	Y	none	No	5	6	6	5
North American porcupine	*Erethizon dorsatum*	-	Y	Y	none	No	2	6	2	4

Common Name	Scientific Name	COSEWIC status*	BC Status**	FN Concern	SARA Schedule*	Identified Wildlife?	Conservation Framework			
							Highest Priority	Goal 1	Goal 2	Goal 3
Yellow-bellied marmot	*Marmota flaviventris*	-	Y	Y	none	No	6	6	6	6
Red squirrel	*Tamiasciurus hudsonicus*	-	Y	Y	none	No	5	6	6	5
Beaver	*Castor canadensis*	-	Y	Y	none	No	5	6	6	5
Common muskrat	*Ondatra zibethicus*	-	Y	Y	none	No	6	6	6	6
Northern pocket gopher	*Thomomys talpoides*	-	Y	Y	none	No	6	6	6	6
Yellow-pine chipmunk	*Neotamias amoenus*	-	Y	Y	none	No	6	6	6	6
North American deermouse	*Peromyscus maniculatus*	-	Y	Y	none	No	6	6	6	6
Big brown bat	*Eptesicus fuscus*	-	Y	-	none	No	6	6	6	6
Silver-haired bat	*Lasionycteris noctivagans*	-	Y	-	none	No	2	6	2	4
Long-eared myotis	*Myotis evotis*	-	Y	n	none	No	2	5	2	4

Common Name	Scientific Name	COSEWIC status*	BC Status**	FN Concern	SARA Schedule*	Identified Wildlife?	Conservation Framework Highest Priority	Goal 1	Goal 2	Goal 3
Little brown myotis	*Myotis lucifugus*	E	Y	Y	none	No	5	6	6	5
Western small-footed myotis	*Myotis ciliolabrum*	-	B	-	none	No	3	6	6	3
Fringed myotis	*Myotis thysanodes*	DD	B	-	3	Yes	3	5	6	3
AMPHIBIANS										
Columbia spotted frog	*Rana luteiventris*	NAR	Y	Y	none	No	2	3	2	4
Great Basin spadefoot	*Spea intermontana*	T	B	Y	1 – T	Yes	1	6	1	2
Long-toed salamander	*Ambystoma macrodactylum*	NAR	Y	n	none	No	4	4	6	5
Northern Pacific treefrog	*Pseudacris regilla*	-	Y	Y	none	No	6	6	6	6
Western toad	*Anaxyrus boreas*	SC	B	Y	1-SC	No	2	3	2	4
REPTILES										
Common gartersnake	*Thamnophis sirtalis*	-	Y	n	none	No	5	6	6	5

Common Name	Scientific Name	COSEWIC status*	BC Status**	FN Concern	SARA Schedule*	Identified Wildlife?	Conservation Framework			
							Highest Priority	Goal 1	Goal 2	Goal 3
Northern rubber boa	*Charina bottae*	SC	Y	Y	1 – SC	No	1	5	1	3
Western terrestrial gartersnake	*Thamnophis elegans*	-	Y	n	none	No	4	4	6	5
				BIRDS						
American Coot	*Fulica americana*	NAR	Y		none	No	2	6	2	4
American Crow	*Corvus brachyrhynchos*	-	Y		none	No	6	6	6	6
American Goldfinch	*Spinus tristis*	-	Y		none	No	2	6	2	4
American Kestrel	*Falco sparverius*	-	Y		none	No	2	6	2	4
American Pipit	*Anthus rubescens*	-	Y		none	No	6	6	6	6
American Robin	*Turdus migratorius*	-	Y		none	No	6	6	6	6
American Wigeon	*Anas americana*	-	Y		none	No	6	6	6	6
Bald Eagle	*Haliaeetus leucocephalus*	NAR	Y	Y	none	No	6	6	6	6

Common Name	Scientific Name	COSEWIC status*	BC Status**	FN Concern	SARA Schedule*	Identified Wildlife?	Conservation Framework			
							Highest Priority	Goal 1	Goal 2	Goal 3
Barrow's Goldeneye	*Bucephala islandica*	-	Y		none	No	1	4	1	3
Baird's Sandpiper	*Calidris bairdii*	-	Unknown		none	No	-	-	-	-
Barn Swallow	*Hirundo rustica*	T	B	Y	none	No	2	6	2	3
Black-billed Magpie	*Pica hudsonia*	-	Y	Y	none	No	6	6	6	6
Black-backed Woodpecker	*Picoides arcticus*	-	Y		none	No	6	6	6	6
Black-capped Chickadee	*Poecile atricapillus*	-	Y	Y	none	No	6	6	6	6
Brown-headed Cowbird	*Molothrus ater*	-	Y		none	No	5	6	6	5
Bank Swallow	*Riparia riparia*	T	Y	Y	none	No	5	5	6	5
Brewer's Blackbird	*Euphagus cyanocephalus*	-	Y		none	No	5	6	6	5
Brewer's Sparrow	*Spizella brewerii*	-	R		none	Yes	2	5	6	2
Bufflehead	*Bucephala albeola*	-	Y		none	No	6	6	6	6

Common Name	Scientific Name	COSEWIC status*	BC Status**	FN Concern	SARA Schedule*	Identified Wildlife?	Conservation Framework			
							Highest Priority	Goal 1	Goal 2	Goal 3
Bullock's Oriole	*Icterus bullockii*	-	Y		none	No	5	6	6	5
Blue-winged Teal	*Anas discors*	-	Y		none	No	2	6	2	4
Cassin's Finch	*Haemorhous cassinii*	-	Y		none	No	5	6	6	5
Canada Goose	*Branta canadensis*	-	Y	Y	none	No	6	6	6	6
Calliope Hummingbird	*Selasphorus calliope*	-	Y		none	No	4	5	4	5
Canvasback	*Aythya valisineria*	-	Y		none	No	2	6	2	4
Cassin's Vireo	*Vireo cassinii*	-	Y		none	No	6	6	6	6
Chestnut-backed Chickadee	*Poecile rufescens*	-	Y		none	No	2	4	2	4
Clay-colored Sparrow	*Spizella pallida*	-	Y		none	No	4	6	4	5
Cedar Waxwing	*Bombycilla cedrorum*	-	Y		none	No	6	6	6	6
Chipping Sparrow	*Spizella passerina*	-	Y		none	No	5	6	6	5

Common Name	Scientific Name	COSEWIC status*	BC Status**	FN Concern	SARA Schedule*	Identified Wildlife?	Conservation Framework			
							Highest Priority	Goal 1	Goal 2	Goal 3
Cinnamon Teal	*Anas cyanoptera*	-	Y		none	No	4	6	4	5
Cackling Goose	*Branta hutchinsii*	-	B		none	No	4	6	6	4
Clark's Nutcracker	*Nucifraga columbiana*	-	Y		none	No	5	5	6	5
Cliff Swallow	*Petrochelidon pyrrhonota*	-	Y		none	No	2	6	2	4
Columbian Sharp-tailed Grouse	*Tympanuchus phasianellus columbianus*	-	B		none	Yes	2	2	6	2
Common Goldeneye	*Bucephala clangula*	-	Y		none	No	3	6	3	4
Cooper's Hawk	*Accipiter cooperii*	NAR	Y		none	No	6	6	6	6
Common Loon	*Gavia immer*	NAR	Y	Y	none	No	6	6	6	6
Common Nighthawk	*Chordeiles minor*	T	Y	Y	1-T	No	2	6	2	4
Common Poorwill	*Phalaenoptilus nuttallii*	DD	Y		none	No	4	6	4	5
Common Raven	*Corvus corax*	-	Y	Y	none	No	5	6	6	5

Common Name	Scientific Name	COSEWIC status*	BC Status**	FN Concern	SARA Schedule*	Identified Wildlife?	Conservation Framework			
							Highest Priority	Goal 1	Goal 2	Goal 3
Common Yellowthroat	*Geothlypis trichas*	-	Y		none	No	5	5	6	6
Dark-eyed Junco	*Junco hyemalis*	-	Y		none	No	5	6	6	5
Downy Woodpecker	*Picoides pubescens*	-	Y		none	No	5	6	6	5
Dusky Flycatcher	*Empidonax oberholseri*	-	Y		none	No	2	6	2	4
Eared Grebe	*Podiceps nigricollis*	-	Y		none	No	4	4	4	5
Eastern Kingbird	*Tyrannus tyrannus*	-	Y		none	No	2	6	2	4
European Starling	*Sturnus vulgaris*	-	Exotic		none	No	6	6	6	6
Eurasian Wigeon	*Anas penelope*	-	No Status		none	No	-	-	-	-
Evening Grosbeak	*Coccothraustes vespertinus*	-	Y		none	No	2	6	2	4
Fox Sparrow	*Passerella iliaca*	-	Y		none	No	5	5	6	6
Gadwall	*Anas strepera*	-	Y		none	No	6	6	6	6

Common Name	Scientific Name	COSEWIC status*	BC Status**	FN Concern	SARA Schedule*	Identified Wildlife?	Conservation Framework			
							Highest Priority	Goal 1	Goal 2	Goal 3
Great Blue Heron	*Ardea herodias herodias*	-	B	Y	none	No	2	6	2	3
Golden-crowned Kinglet	*Regulus satrapa*	-	Y		none	No	5	5	6	5
Golden-crowned Sparrow	*Zonotrichia atricapilla*	-	Y		none	No	6	6	6	6
Great Gray Owl	*Strix nebulosa*	NAR	Y		none	No	4	6	4	5
Great Horned Owl	*Bubo virginianus*	-	Y	Y	none	No	6	6	6	6
Golden Eagle	*Aquila chrysaetos*	NAR	Y	Y	none	No	4	6	4	5
Gray Jay	*Perisoreus canadensis*	-	Y	Y	none	No	6	6	6	6
Greater Scaup	*Aythya marila*	-	Y		none	No	2	6	2	4
Greater Yellowlegs	*Tringa melanoleuca*	-	Y		none	No	6	6	6	6
Green-winged Teal	*Anas crecca*	-	Y		none	No	5	6	6	5

Common Name	Scientific Name	COSEWIC status*	BC Status**	FN Concern	SARA Schedule*	Identified Wildlife?	Conservation Framework Highest Priority	Goal 1	Goal 2	Goal 3
Hammond's Flycatcher	*Empidonax hammondii*	-	Y		none	No	5	5	6	6
Hairy Woodpecker	*Picoides villosus*	-	Y		none	No	5	5	6	6
House Finch	*Haemorhous mexicanus*	-	Y		none	No	6	6	6	6
Horned Grebe	*Podiceps auritus*	SC	Y	Y	none	No	4	4	4	5
Horned Lark	*Eremophila alpestris*	-	Y		none	No	2	6	2	4
Hooded Merganser	*Lophodytes cucullatus*	-	Y		none	No	6	6	6	6
House Wren	*Troglodytes aedon*	-	Y		none	No	5	6	6	5
Killdeer	*Charadrius vociferus*	-	Y		none	No	2	6	2	4
Least Flycatcher	*Empidonax minimus*	-	Y		none	No	6	6	6	6
Long-eared Owl	*Asio otus*	-	Y		none	No	4	6	4	5

Common Name	Scientific Name	COSEWIC status*	BC Status**	FN Concern	SARA Schedule*	Identified Wildlife?	Conservation Framework			
							Highest Priority	Goal 1	Goal 2	Goal 3
Lesser Scaup	*Aythya affinis*	-	Y		none	No	2	6	2	4
Lewis's Woodpecker	*Melanerpes lewis*	T	R	Y	1-T	Yes	2	3	6	2
Lesser Yellowlegs	*Tringa flavipes*	-	Y		none	No	5	6	6	5
MacGillivray's Warbler	*Geothlypis tolmiei*	-	Y		none	No	5	6	6	5
Mallard	*Anas platyrhynchos*	-	Y		none	No	5	6	6	5
Marsh Wren	*Cistothorus palustris*	-	Y		none	No	5	5	6	6
Merlin	*Falco columbarius*	NAR	Y		none	No	6	6	6	6
Mountain Bluebird	*Sialia currucoides*	-	Y		none	No	4	4	6	5
Mountain Chickadee	*Poecile gambeli*	-	Y		none	No	6	6	6	6
Mourning Dove	*Zenaida macroura*	-	Y		none	No	2	6	2	4
Northern Flicker	*Colaptes auratus*	-	Y	Y	none	No	6	6	6	6
Northern Goshawk	*Accipiter gentilis*	-	Y		none	No	3	6	3	4

Common Name	Scientific Name	COSEWIC status*	BC Status**	FN Concern	SARA Schedule*	Identified Wildlife?	Conservation Framework			
							Highest Priority	Goal 1	Goal 2	Goal 3
Northern Harrier	*Circus cyaneus*	NAR	Y		none	No	2	4	2	4
Northern Pintail	*Anas acuta*	-	Y		none	No	2	6	2	4
Northern Shrike	*Lanius excubitor*	-	Y		none	No	4	6	4	5
Northern Shoveler	*Anas clypeata*	-	Y		none	No	6	6	6	6
Northern Waterthrush	*Parkesia noveboracensis*	-	Y		none	No	6	6	6	6
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	-	Y		none	No	2	6	2	4
Orange-crowned Warbler	*Oreothlypis celata*	-	Y		none	No	5	6	6	5
Olive-sided Flycatcher	*Contopus cooperi*	T	B	Y	1-T	No	2	5	2	3
Osprey	*Pandion haliaetus*	-	Y	Y	none	No	6	6	6	6
Pied-billed Grebe	*Podilymbus podiceps*	-	Y		none	No	2	6	2	4
Peregrine Falcon	*Falco peregrinus anatum*	SC	R	y	1-SC	No	2	5	2	3

Common Name	Scientific Name	COSEWIC status*	BC Status**	FN Concern	SARA Schedule*	Identified Wildlife?	Conservation Framework			
							Highest Priority	Goal 1	Goal 2	Goal 3
Pine Siskin	*Spinus pinus*	-	Y		none	No	2	6	2	4
Pileated Woodpecker	*Dryocopus pileatus*	-	Y	Y	none	No	4	6	6	4
Prairie Falcon	*Falco mexicanus*	NAR	R		none	Y	2	6	6	2
Purple Finch	*Haemorhous purpureus*	-	Y		none	No	2	6	2	4
Pygmy Nuthatch	*Sitta pygmaea*	-	Y		none	No	4	4	4	5
Red-breasted Merganser	*Mergus serrator*	-	Y		none	No	4	6	4	5
Red-breasted Nuthatch	*Sitta canadensis*	-	Y		none	No	5	5	6	6
Ruby-crowned Kinglet	*Regulus calendula*	-	Y		none	No	5	5	6	6
Red Crossbill	*Loxia curvirostra*	-	Y		none	No	2	6	2	4
Redhead	*Aythya americana*	-	Y		none	No	2	6	2	4
Rough-legged Hawk	*Buteo lagopus*	NAR	B		none	No	2	6	6	2
Ring-necked Duck	*Aythya collaris*	-	Y		none	No	6	6	6	6

Common Name	Scientific Name	COSEWIC status*	BC Status**	FN Concern	SARA Schedule*	Identified Wildlife?	Conservation Framework			
							Highest Priority	Goal 1	Goal 2	Goal 3
Red-necked Grebe	*Podiceps grisegena*	NAR	Y		none	No	4	6	4	5
Red-naped Sapsucker	*Sphyrapicus nuchalis*	-	Y		none	No	5	5	6	5
Rock Pigeon	*Columba livia*	-	Exotic		none	No	6	6	6	6
Rock Wren	*Salpinctes obsoletus*	-	Y		none	No	2	6	2	4
Red-tailed Hawk	*Buteo jamaicensis*	NAR	Y		none	No	6	6	6	6
Ruddy Duck	*Oxyura jamaicensis*	-	Y		none	No	6	6	6	6
Ruffed Grouse	*Bonasa umbellus*	-	Y	Y	none	No	2	4	2	4
Rufous Hummingbird	*Selasphorus rufus*	-	Y		none	No	2	4	2	4
Red-winged Blackbird	*Agelaius phoeniceus*	-	Y		none	No	5	5	6	5
Sandhill Crane	*Grus canadensis*	NAR	Y	Y	none	Yes	5	6	6	5
Say's Phoebe	*Sayornis saya*	-	Y		none	No	6	6	6	6

Common Name	Scientific Name	COSEWIC status*	BC Status**	FN Concern	SARA Schedule*	Identified Wildlife?	Conservation Framework			
							Highest Priority	Goal 1	Goal 2	Goal 3
Savannah Sparrow	*Passerculus sandwichensis*	-	Y		none	No	6	6	6	6
Short-eared Owl	*Asio flammeus*	SC	B	Y	1-SC	Yes	2	6	2	3
Sora	*Porzana carolina*	-	Y		none	No	5	5	6	6
Song Sparrow	*Melospiza melodia*	-	Y		none	No	6	6	6	6
Spotted Sandpiper	*Actitis macularius*	-	Y		none	No	5	6	6	5
Sharp-shinned Hawk	*Accipiter striatus*	NAR	Y		none	No	6	6	6	6
Sharp-tailed Grouse	*Tympanuchus phasianellus*	-	Y	Y	none	No	2	3	2	4
Swainson's Hawk	*Buteo swainsoni*	-	R	Y	none	No	2	6	6	2
Swainson's Thrush	*Catharus ustulatus*	-	Y		none	No	2	6	2	4
Townsend's Solitaire	*Myadestes townsendi*	-	Y		none	No	2	5	2	4
Townsend's Warbler	*Setophaga townsendi*	-	Y		none	No	5	5	6	6

Common Name	Scientific Name	COSEWIC status*	BC Status**	FN Concern	SARA Schedule*	Identified Wildlife?	Conservation Framework			
							Highest Priority	Goal 1	Goal 2	Goal 3
Tree Swallow	*Tachycineta bicolor*	-	Y		none	No	2	6	2	4
Trumpeter Swan	*Cygnus buccinator*	NAR	Y	Y	none	No	5	5	6	5
Turkey Vulture	*Cathartes aura*	-	Y		none	No	5	6	6	5
Vesper Sparrow	*Pooecetes gramineus*	-	Y		none	No	2	6	2	4
Violet-green Swallow	*Tachycineta thalassina*	-	Y		none	No	2	4	2	4
Virginia Rail	*Rallus limicola*	-	Y		none	No	2	6	2	4
Warbling Vireo	*Vireo gilvus*	-	Y		none	No	6	6	6	6
White-breasted Nuthatch	*Sitta carolinensis*	-	Y		none	No	4	6	4	5
White-crowned Sparrow	*Zonotrichia leucophrys*	-	Y		none	No	6	6	6	6
Western Bluebird	*Sialia mexicana*	-	Y		none	No	4	4	4	5
Western Kingbird	*Tyrannus verticalis*	-	Y		none	No	4	6	4	5

Common Name	Scientific Name	COSEWIC status*	BC Status**	FN Concern	SARA Schedule*	Identified Wildlife?	Conservation Framework			
							Highest Priority	Goal 1	Goal 2	Goal 3
Western Meadowlark	*Sturnella neglecta*	-	Y	Y	none	No	2	6	2	4
Western Sandpiper	*Calidris mauri*	-	Y		none	No	2	6	2	4
Western Tanager	*Piranga ludoviciana*	-	Y		none	No	6	6	6	6
Willow Flycatcher	*Empidonax traillii*	-	Y		none	No	2	6	2	4
Wilson's Phalarope	*Phalaropus tricolor*	-	Y		none	No	2	4	2	4
Wilson's Snipe	*Gallinago delicata*	-	Y		none	No	2	6	2	4
Wilson's Warbler	*Cardellina pusilla*	-	Y		none	No	2	5	2	4
Winter Wren	*Troglodytes hiemalis*	-	Y	Y	none	No	-	-	-	-
Western Wood-Pewee	*Contopus sordidulus*	-	Y		none	No	2	6	2	4
Yellow Warbler	*Setophaga petechia*	-	Y		none	No	2	6	2	4
Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*	-	Y		none	No	2	6	2	4

Common Name	Scientific Name	COSEWIC status*	BC Status**	FN Concern	SARA Schedule*	Identified Wildlife?	Conservation Framework			
							Highest Priority	Goal 1	Goal 2	Goal 3
Yellow-rumped Warbler	*Setophaga coronata*	-	Y		none	No	5	6	6	5

*E=Endangered, T=Threatened, SC=Special Concern, NAR = Not At Risk; DD= Data deficient.

** R = Red-listed (Endandered or Threatened), B = Blue-listed (Special Concern formerly Vulnerable), Y= Yellow-listed (Secure and Not At Risk)

APPENDIX 8 PLANT TAXA DOCUMENTED DURING FIELD SURVEYS

Taxon	Common Name	First Nations Use
Vascular Plants		
Acer glabrum var. *douglasii*	Douglas Maple	✓
Acer negundo	Box-elder	
Achillea millefolium var. *lanulosa*	Yarrow	✓
Achnatherum hymenoides	Indian Ricegrass	
Achnatherum nelsonii ssp. *dorei*	Columbia Needlegrass	
Achnatherum richardsonii	Spreading Needlegrass	
Acmispon denticulatus	Meadow Birds-foot Trefoil	
Acroptilon repens	Russian Knapweed	
Actaea rubra	Baneberry	✓
Agoseris glauca	Short-beaked agoseris	✓
Agoseris glauca var. *glauca*	Prairie Agoseris	
Agoseris grandiflora	Large-flowered Agoseris	
Agropyron cristatum ssp. *pectinatum*	Crested Wheatgrass	
Agrostis exarata	Spike Bentgrass	
Agrostis gigantea	Redtop	
Agrostis stolonifera	Creeping Bentgrass	
Alisma gramineum	Narrow-leaved Water-plantain	
Allium cernuum var. *cernuum*	Nodding Onion	✓
Alopecurus aequalis	Little Meadow-foxtail	
Alyssum alyssoides	Pale Alyssum	
Amaranthus blitoides	Prostrate Pigweed	
Amelanchier alnifolia	Saskatoon	✓
Anaphalis margaritacea	Pearly Everlasting	
Anemone multifida	Cut-leaved Anemone	✓
Anemone multifida var. *multifida*	Cut-leaved Anemone	✓
Antennaria anaphaloides	Showy Pussytoes	
Antennaria dimorpha	Low Pussytoes	✓
Antennaria howellii ssp. *howellii*	Howell's Pussytoes	
Antennaria microphylla	White Pussytoes	
Antennaria parvifolia	Nuttall's Pussytoes	
Antennaria racemosa	Racemose Pussytoes	
Antennaria rosea	Rosy Pussytoes	✓
Antennaria umbrinella	Umber Pussytoes	
Arabidopsis thaliana	Mouse-ear	
Aralia nudicaulis	Wild Sarsaparilla	✓
Arctium lappa	Great Burdock	
Arctium minus	Common Burdock	
Arctostaphylos uva-ursi	Kinnikinnick	✓
Arenaria serpyllifolia	Thyme-leaved Sandwort	

Taxon	Common Name	First Nations Use
Aristida purpurea var. *longiseta*	Red Three-awn	
Arnica cordifolia	Heart-leaved Arnica	✓
Arnica sororia	Twin Arnica	
Artemisia biennis	Biennial Wormwood	
Artemisia campestris	Northern Wormwood	✓
Artemisia campestris ssp. *pacifica*	Northern Wormwood	✓
Artemisia dracunculus	Tarragon	✓
Artemisia frigida	Prairie Sagewort	
Artemisia michauxiana	Michaux's Mugwort	
Artemisia tridentata ssp. *tridentata*	Big Sagebrush	✓
Asclepias speciosa	Showy Milkweed	✓
Asparagus officinalis	Garden Asparagus	
Asperugo procumbens	Madwort	
Astragalus agrestis	Field Milk-vetch	
Astragalus beckwithii var. *weiserensis*	Weiser Milk-vetch	
Astragalus canadensis	Canadian Milk-vetch	
Astragalus collinus var. *collinus*	Hillside Milk-vetch	
Astragalus laxmannii var. *robustior*	Standing Milk-vetch	
Astragalus lentiginosus var. *lentiginosus*	Freckled Milk-vetch	
Astragalus miser var. *serotinus*	Timber Milk-vetch	✓
Astragalus purshii var. *purshii*	Woollypod Milk-vetch	✓
Astragalus tenellus	Pulse Milk-vetch	
Athyrium filix-femina ssp. *cyclosorum*	Lady Fern	✓
Atriplex micrantha	Russian Orache	
Atriplex oblongifolia	Oblong-leaved Orache	
Atriplex patula	Common Orache	
Atriplex rosea	Red Orache	
Atriplex truncata	Wedgescale Orache	
Avena sativa	Common Oat	
Balsamorhiza sagittata	Arrowleaf Balsamroot	✓
Barbarea orthoceras	American Wintercress	
Bassia hyssopifolia	Five-hooked Bassia	
Beckmannia syzigachne	American Sloughgrass	
Berteroa incana	Hoary Alyssum	
Betula occidentalis	Water Birch	✓
Boechera collinsii	Collins' Suncress	
Boechera grahamii	Graham's Suncress	
Boechera macounii	Sloppy Suncress	
Boechera pauciflora	Fuzzy Suncress	
Boechera pendulocarpa	Earless Suncress	
Boechera retrofracta	Dangling Suncress	
Bolboschoenus maritimus var. *paludosus*	Seacoast Bulrush	
Bouteloua gracilis	Blue Grama	

Taxon	Common Name	First Nations Use
Bromus carinatus	California Brome	
Bromus ciliatus	Fringed Brome	
Bromus hordeaceus	Soft Brome	
Bromus hordeaceus ssp. *hordeaceus*	Soft Brome	
Bromus inermis	Smooth Brome	
Bromus japonicus	Japanese Brome	
Bromus porteri	Porter's Brome	
Bromus pumpellianus ssp. *pumpellianus*	Pumpelly Brome	
Bromus tectorum	Cheatgrass	
Calamagrostis canadensis	Bluejoint Reedgrass	
Calamagrostis rubescens	Pinegrass	✓
Calamagrostis stricta ssp. *stricta*	Slimstem Reedgrass	
Calochortus macrocarpus var. *macrocarpus*	Sagebrush Mariposa Lily	✓
Camelina microcarpa	Littlepod Flax	
Campanula rotundifolia	Common Harebell	
Canadanthus modestus	Great Northern Aster	
Capsella bursa-pastoris	Shepherd's Purse	
Carex atherodes	Awned Sedge	
Carex concinnoides	Northwestern Sedge	✓
Carex douglasii	Douglas' Sedge	✓
Carex filifolia	Thread-leaved Sedge	✓
Carex hoodii	Hood's Sedge	✓
Carex pellita	Woolly Sedge	✓
Carex petasata	Pasture Sedge	✓
Carex praegracilis	Field Sedge	✓
Carex praticola	Meadow Sedge	✓
Carex rossii	Ross' Sedge	✓
Carex siccata	Hay Sedge	✓
Carex utriculata	Beaked Sedge	✓
Castilleja hispida var. *hispida*	Harsh Paintbrush	
Castilleja lutescens	Yellowish Paintbrush	
Castilleja miniata var. *miniata*	Scarlet Paintbrush	
Castilleja thompsonii	Thompson's Paintbrush	✓
Centaurea diffusa	Diffuse Knapweed	
Centaurea stoebe ssp. *micranthos*	Spotted Knapweed	
Cerastium arvense	Field Chickweed	
Cerastium fontanum ssp. *triviale*	Mouse-ear Chickweed	
Ceratophyllum demersum	Common Hornwort	
Chaenactis douglasii var. *douglasii*	Hoary False Yarrow	✓
Chenopodium album	Lamb's-quarters	
Chenopodium berlandieri var. *zschackei*	Pitseed Goosefoot	
Chenopodium desiccatum	Narrow-leaved Goosefoot	
Chenopodium fremontii var. *fremontii*	Fremont's Goosefoot	

Taxon	Common Name	First Nations Use
Chenopodium glaucum	Oak-leaved Goosefoot	
Chenopodium pratericola	Desert Goosefoot	
Chenopodium rubrum var. *humile*	Red Goosefoot	
Chenopodium rubrum var. *rubrum*	Red Goosefoot	
Chenopodium simplex	Maple-leaved Goosefoot	
Cicuta douglasii	Douglas' Water-hemlock	✓
Cinna latifolia	Nodding Wood-reed	
Cirsium arvense	Canada Thistle	
Cirsium flodmanii	Flodman's thistle	
Cirsium hookerianum	Hooker's Thistle	
Cirsium undulatum	Wavy-leaved Thistle	
Cirsium vulgare	Bull Thistle	
Clematis occidentalis ssp. *grosseserrata*	Columbia Bower	✓
Collinsia parviflora	Small-flowered Blue-eyed Mary	
Collomia linearis	Narrow-leaved Collomia	✓
Comandra umbellata var. *pallida*	Pale Comandra	✓
Conyza canadensis	Horseweed	
Cornus stolonifera	Red-osier Dogwood	✓
Corydalis aurea	Golden Corydalis	
Crepis atribarba	Slender Hawksbeard	✓
Crepis occidentalis ssp. *occidentalis*	Western Hawksbeard	
Crepis tectorum	Annual Hawksbeard	
Cynoglossum officinale	Common Hound's-tongue	
Cystopteris fragilis	Fragile Fern	
Dactylis glomerata	Orchard grass	
Danthonia intermedia	Timber Oatgrass	
Danthonia spicata	Poverty Oatgrass	
Delphinium nuttallianum	Upland Larkspur	
Descurainia incana	Mountain Tansymustard	
Descurainia incisa ssp. *incisa*	Richardson's Tansymustard	
Descurainia nelsonii	Nelson's Tansymustard	
Descurainia pinnata ssp. *brachycarpa*	Short-fruited Tansymustard	
Descurainia sophia	Flixweed	
Dianthus deltoides	Maiden Pink	
Distichlis spicata	Seashore Saltgrass	
Distichlis spicata var. *stricta*	Alkali Saltgrass	
Dodecatheon pulchellum var. *pulchellum*	Pretty Shootingstar	✓
Draba nemorosa	Woods Draba	
Draba verna	Common Draba	
Dracocephalum parviflorum	American Dragonhead	
Drymocallis convallaria	White Cinquefoil	
Elaeagnus angustifolia	Russian Olive	
Eleocharis macrostachya	Creeping Spike-rush	

Taxon	Common Name	First Nations Use
Eleocharis mamillata ssp. *mamillata*	Nipple Spike-rush	
Eleocharis palustris	Common Spike-rush	✓
Elymus elymoides ssp. *elymoides*	Squirreltail Grass	
Elymus glaucus ssp. *glaucus*	Blue Wildrye	✓
Elymus lanceolatus ssp. *lanceolatus*	Thickspike Wildrye	
Elymus repens	Quackgrass	
Elymus trachycaulus ssp. *subsecundus*	Slender Wheatgrass	
Elymus trachycaulus ssp. *trachycaulus*	Slender Wheatgrass	
Epilobium angustifolium	Fireweed	✓
Epilobium brachycarpum	Tall Annual Willowherb	
Epilobium ciliatum ssp. *ciliatum*	Purple-leaved Willowherb	
Epilobium ciliatum ssp. *glandulosum*	Purple-leaved Willowherb	
Epilobium halleanum	Hall's Willowherb	
Epilobium minutum	Small-flowered Willowherb	
Equisetum arvense	Common Horsetail	✓
Equisetum fluviatile	Swamp Horsetail	
Equisetum laevigatum	Smooth Scouring-rush	✓
Eremogone capillaris var. *americana*	Thread-leaved Sandwort	
Ericameria nauseosa var. *speciosa*	Common Rabbit-brush	✓
Erigeron annuus	Annual Fleabane	
Erigeron compositus	Cut-leaved Daisy	✓
Erigeron corymbosus	Long-leaved Fleabane	
Erigeron divergens	Diffuse Fleabane	
Erigeron filifolius	Thread-leaved Fleabane	✓
Erigeron flagellaris	Trailing Fleabane	
Erigeron linearis	Linear-leaved Daisy	✓
Erigeron lonchophyllus	Spear-leaved Fleabane	
Erigeron philadelphicus var. *philadelphicus*	Philadelphia Fleabane	
Erigeron pumilus var. *intermedius*	Shaggy Fleabane	✓
Erigeron speciosus	Showy Daisy	
Eriogonum heracleoides var. *angustifolium*	Parsnip-flowered Buckwheat	✓
Erysimum cheiranthoides	Wormseed Mustard	
Erysimum inconspicuum	Small Wallflower	
Eurybia conspicua	Showy Aster	✓
Euthamia occidentalis	Western Goldenrod	
Fallopia convolvulus	Black Bindweed	
Festuca campestris	Rough Fescue	
Festuca idahoensis	Idaho Fescue	
Festuca occidentalis	Western Fescue	
Festuca rubra	Red Fescue	
Festuca rubra ssp. *rubra*	Red Fescue	
Festuca saximontana	Rocky Mountain Fescue	
Fragaria vesca	Wood Strawberry	✓

Taxon	Common Name	First Nations Use
Fragaria virginiana	Wild Strawberry	✓
Fragaria virginiana var. *glauca*	Wild Strawberry	✓
Fritillaria pudica	Yellow Bell	✓
Gaillardia aristata	Brown-eyed Susan	✓
Galium aparine	Cleavers	
Galium boreale	Northern Bedstraw	
Galium trifidum	Small Bedstraw	
Galium triflorum	Sweet-scented Bedstraw	✓
Galium verum	Yellow Bedstraw	
Gentianella amarella ssp. *acuta*	Northern Gentian	
Geranium viscosissimum var. *viscosissimum*	Sticky Purple Geranium	✓
Geum macrophyllum ssp. *perincisum*	Large-leaved Avens	✓
Geum triflorum var. *ciliatum*	Old Man's Whiskers	✓
Glyceria elata	Tall Mannagrass	
Glyceria striata	Fowl Mannagrass	
Gnaphalium uliginosum	Marsh Cudweed	
Goodyera oblongifolia	Rattlesnake-plantain	✓
Grindelia squarrosa	Curly-cup Gumweed	✓
Grindelia squarrosa var. *serrulata*	Curly-cup Gumweed	✓
Hackelia deflexa ssp. *americana*	Nodding Stickseed	
Hackelia floribunda	Many-flowered Stickseed	
Helianthella uniflora var. *douglasii*	Rocky Mountain Helianthella	
Heracleum maximum	Cow-parsnip	✓
Hesperostipa comata	Needle-and-thread Grass	✓
Hesperostipa comata ssp. *comata*	Needle-and-thread Grass	✓
Heterotheca villosa var. *villosa*	Golden-aster	
Heuchera cylindrica	Round-leaved Alumroot	✓
Hieracium albiflorum	White Hawkweed	
Hieracium scouleri	Scouler's Hawkweed	✓
Hippuris vulgaris	Common Mare's-tail	
Hordeum jubatum ssp. *intermedium*	Foxtail Barley	
Hordeum jubatum ssp. *jubatum*	Foxtail Barley	
Hornungia procumbens	Ovalpurse	
Juncus balticus ssp. *ater*	Baltic Rush	
Juncus bufonius	Toad Rush	
Juniperus communis	Common Juniper	✓
Juniperus scopulorum	Rocky Mountain Juniper	✓
Kochia scoparia	Summer-cypress	
Koeleria macrantha	Junegrass	
Lactuca serriola	Prickly Lettuce	
Lappula occidentalis var. *occidentalis*	Western Stickseed	
Lappula squarrosa	Bristly Stickseed	
Lathyrus ochroleucus	Creamy Peavine	

Taxon	Common Name	First Nations Use
Lemna minor	Common Duckweed	
Lemna trisulca	Ivy-leaved Duckweed	
Lepidium densiflorum	Prairie Pepper-grass	
Lepidium draba	Heart-podded Hoarycress	
Lepidium perfoliatum	Clasping-leaved Pepper-grass	
Leucanthemum vulgare	Oxeye Daisy	
Leymus cinereus	Giant Wildrye	✓
Lilium columbianum	Tiger Lily	✓
Linaria genistifolia ssp. *dalmatica*	Dalmatian Toadflax	
Linaria vulgaris	Butter-and-eggs	
Linnaea borealis	Twinflower	✓
Linnaea borealis ssp. *borealis*	Twinflower	✓
Linum lewisii ssp. *lewisii*	Western Blue Flax	✓
Lithophragma glabrum	Smooth Fringecup	
Lithophragma parviflorum var. *parviflorum*	Small-flowered Fringecup	
Lithospermum incisum	Yellow Gromwell	
Lithospermum ruderale	Lemonweed	✓
Logfia arvensis	Field Filago	
Lolium perenne	Perennial Ryegrass	
Lomatium ambiguum	Swale Desert-parsley	
Lomatium dissectum var. *multifidum*	Fern-leaved Desert-parsley	✓
Lomatium macrocarpum	Large-fruited Desert-parsley	✓
Lomatium triternatum ssp. *triternatum*	Nine-leaved Desert-parsley	✓
Lonicera involucrata	Black Twinberry	✓
Lupinus leucophyllus var. *leucophyllus*	Velvet Lupine	
Lupinus sericeus var. *sericeus*	Silky Lupine	
Luzula campestris ssp. *campestris*	Field Wood-rush	
Lycopus americanus	Cut-leaved Water Horehound	
Lycopus uniflorus	Northern Water Horehound	
Lysimachia ciliata	Fringed Loosestrife	
Mahonia aquifolium	Tall Oregon-grape	
Mahonia aquifolium x repens	Oregon-grape	
Maianthemum stellatum	Star-flowered False Solomon's-seal	
Matricaria discoidea	Pineapple Weed	✓
Medicago lupulina	Black Medic	
Medicago sativa ssp. *falcata*	Alfalfa	
Medicago sativa ssp. *sativa*	Alfalfa	
Melilotus alba	White Sweet-clover	
Melilotus officinalis	Yellow Sweet-clover	
Mentha arvensis	Field Mint	✓
Micranthes nidifica	Meadow Saxifrage	
Microseris nutans	Nodding Microseris	
Microsteris gracilis	Pink Twink	

Taxon	Common Name	First Nations Use
Microsteris gracilis var. *humilior*	Pink Twink	
Moehringia lateriflora	Blunt-leaved Sandwort	
Monolepis nuttalliana	Poverty Weed	
Muhlenbergia asperifolia	Alkali Muhly	
Muhlenbergia richardsonis	Mat Muhly	
Mulgedium pulchellum	Blue Lettuce	
Mycelis muralis	Wall Lettuce	
Myosotis laxa	Small-flowered Forget-me-not	
Myosotis stricta	Blue Forget-me-not	
Myriophyllum verticillatum	Verticillate Water-milfoil	
Nassella viridula	Green Needlegrass	
Nasturtium officinale	Common Watercress	
Onobrychis viciifolia	Sainfoin	
Opuntia fragilis	Brittle Prickly-pear Cactus	✓
Orobanche fasciculata	Clustered Broomrape	
Orobanche ludoviciana var. *arenosa*	Suksdorf's Broomrape	
Orthilia secunda	One-sided Wintergreen	
Orthocarpus luteus	Yellow Owl-clover	
Osmorhiza berteroi	Mountain Sweet-cicely	✓
Oxytropis campestris var. *varians*	Field Locoweed	
Packera pseudaurea var. *pseudaurea*	Streambank Butterweed	
Packera streptanthifolia	Rocky Mountain Butterweed	
Pascopyrum smithii	Western Bluegrass	
Penstemon confertus	Yellow Penstemon	✓
Penstemon fruticosus	Shrubby Penstemon	✓
Penstemon fruticosus var. *fruticosus*	Shrubby Penstemon	✓
Penstemon procerus var. *procerus*	Small-flowered Penstemon	
Persicaria amphibia	Water Smartweed	
Persicaria amphibia var. *emersa*	Water Smartweed	
Phalaris arundinacea	Reed Canarygrass	
Phleum pratense	Common Timothy	
Physostegia parviflora	Purple Dragonhead	
Picea engelmannii x glauca	Hybrid White Spruce	✓
Picea glauca	White Spruce	✓
Pinus contorta var. *latifolia*	Lodgepole Pine	✓
Pinus ponderosa	Ponderosa Pine	✓
Plantago lanceolata	Ribwort Plantain	
Plantago major	Common Plantain	✓
Plantago patagonica	Woolly Plantain	✓
Poa compressa	Canada Bluegrass	
Poa cusickii	Cusick's Bluegrass	
Poa fendleriana ssp. *longiligula*	Mutton Grass	
Poa nemoralis	Woods Bluegrass	

Taxon	Common Name	First Nations Use
Poa palustris	Fowl Bluegrass	
Poa pratensis	Kentucky Bluegrass	
Poa pratensis ssp. *pratensis*	Kentucky Bluegrass	
Poa secunda ssp. *juncifolia*	Nevada Bluegrass	
Poa secunda ssp. *secunda*	Sandberg's Bluegrass	
Poa wheeleri	Wheeler's Bluegrass	
Polygonum achoreum	Blake's Knotweed	
Polygonum aviculare	Common Knotweed	
Polygonum douglasii	Douglas's knotweed	
Polygonum ramosissimum	Yellow-flowered Knotweed	
Polygonum spergulariiforme	Spurry Knotweed	
Polypogon interruptus	Ditch Rabbit's-foot grass	
Polypogon monspeliensis	Rabbitfoot Polypogon	
Populus tremuloides	Trembling Aspen	✓
Populus trichocarpa	Black Cottonwood	✓
Potamogeton pusillus	Small Pondweed	
Potamogeton pusillus ssp. *pusillus*	Small Pondweed	
Potamogeton richardsonii	Richardson's Pondweed	
Potentilla anserina	Common Silverweed	
Potentilla argentea	Silvery Cinquefoil	
Potentilla biennis	Biennial Cinquefoil	
Potentilla bipinnatifida	Bipinnate Cinquefoil	
Potentilla gracilis var. *fastigiata*	Graceful Cinquefoil	✓
Potentilla hippiana var. *hippiana*	Woolly Cinquefoil	✓
Potentilla norvegica	Norwegian Cinquefoil	✓
Potentilla pensylvanica var. *pensylvanica*	Pennsylvanian Cinquefoil	
Potentilla recta	Sulphur Cinquefoil	
Prosartes trachycarpa	Rough-fruited Fairybells	
Prunella vulgaris ssp. *lanceolata*	Self-heal	✓
Prunus virginiana ssp. *melanocarpa*	Choke Cherry	✓
Psathyrostachys juncea	Russian Wildrye	
Pseudoroegneria spicata	Bluebunch Wheatgrass	
Pseudotsuga menziesii	Douglas-fir	✓
Puccinellia distans	Weeping Alkaligrass	
Puccinellia nuttalliana	Nuttall's Alkaligrass	
Pyrola asarifolia	Pink Wintergreen	✓
Ranunculus cymbalaria	Shore Buttercup	
Ranunculus flabellaris	Yellow Water-buttercup	
Ranunculus glaberrimus	Sagebrush Buttercup	✓
Ranunculus gmelinii	Small Yellow Water-buttercup	
Ranunculus macounii	Macoun's Buttercup	
Ranunculus pensylvanicus	Pennsylvania Buttercup	
Ranunculus sceleratus	Celery-leaved Buttercup	

Taxon	Common Name	First Nations Use
Ranunculus sceleratus var. *multifidus*	Celery-leaved Buttercup	
Ranunculus testiculatus	Hornseed Buttercup	
Rhinanthus minor	Yellow Rattle	
Ribes cereum var. *cereum*	Squaw Currant	✓
Ribes lacustre	Black Gooseberry	✓
Ribes oxyacanthoides ssp. *irriguum*	Northern Gooseberry	
Rorippa curvisiliqua	Western Yellowcress	
Rorippa palustris	Marsh Yellowcress	
Rosa acicularis ssp. *sayi*	Prickly Rose	✓
Rosa canina	Dog Rose	
Rosa nutkana var. *hispida*	Nootka Rose	
Rosa nutkana var. *nutkana*	Nootka Rose	
Rosa woodsii ssp. *ultramontana*	Prairie Rose	✓
Rubus idaeus ssp. *strigosus*	Red Raspberry	✓
Rumex crispus	Curled Dock	
Rumex fueginus	Golden Dock	
Ruppia cirrhosa	Spiral Ditch-grass	
Salicornia rubra	Red Glasswort	
Salix bebbiana	Bebb's Willow	✓
Salix drummondiana	Drummond's Willow	✓
Salix exigua var. *exigua*	Narrow-leaf Willow	✓
Salix lasiandra var. *lasiandra*	Pacific Willow	✓
Salix pseudomyrsinites	Tall Blueberry Willow	✓
Salix scouleriana	Scouler's Willow	✓
Salsola tragus	Russian Thistle	
Saxifraga bronchialis ssp. *austromontana*	Spotted Saxifrage	
Schedonorus pratensis	Meadow Fescue	
Schoenoplectus acutus	Hard-stemmed Bulrush	
Schoenoplectus pungens var. *longispicatus*	American Bulrush	
Scirpus microcarpus	Small-flowered Bulrush	✓
Scutellaria galericulata	Marsh Skullcap	
Sedum lanceolatum	Lance-leaved Stonecrop	✓
Sedum lanceolatum var. *lanceolatum*	Lance-leaved Stonecrop	✓
Selaginella wallacei	Wallace's Selaginella	
Senecio integerrimus var. *exaltatus*	Western Groundsel	
Shepherdia canadensis	Soopolallie	✓
Silene douglasii var. *douglasii*	Douglas' Campion	
Silene latifolia ssp. *alba*	White Cockle	
Silene menziesii	Menzies' Campion	✓
Silene menziesii var. *menziesii*	Menzies' Campion	✓
Silene noctiflora	Night-flowering Catchfly	✓
Sisymbrium altissimum	Tall Tumble-mustard	
Sisymbrium loeselii	Loesel's Tumble-mustard	

Taxon	Common Name	First Nations Use
Sisyrinchium idahoense var. *idahoense*	Idaho Blue-eyed-grass	
Sisyrinchium montanum	Mountain Blue-eyed-grass	
Sium suave	Hemlock Water-parsnip	✓
Solanum dulcamara var. *dulcamara*	European Bittersweet	
Solanum triflorum	Cut-leaved Nightshade	
Solidago lepida	Canada Goldenrod	
Solidago missouriensis	Missouri Goldenrod	
Solidago simplex	Spikelike Goldenrod	
Sonchus arvensis	Perennial Sow-thistle	
Sparganium sp.	Bur-reed	
Spartina gracilis	Alkali Cordgrass	
Spergularia salina var. *salina*	Salt Marsh Sand-spurry	
Spiraea betulifolia ssp. *lucida*	Birch-leaved Spirea	✓
Spirodela polyrhiza	Great Duckweed	
Sporobolus cryptandrus	Sand Dropseed	
Stachys palustris ssp. *pilosa*	Swamp Hedge-nettle	
Stellaria media	Common Chickweed	
Stephanomeria tenuifolia	Narrow-leaved Stephanomeria	
Stuckenia pectinata	Fennel-leaved Pondweed	
Stuckenia vaginata	Sheathing Pondweed	
Suaeda calceoliformis	Seablite	
Symphoricarpos albus	Common Snowberry	✓
Symphyotrichum campestre	Meadow Aster	
Symphyotrichum ciliatum	Rayless Alkali Aster	
Symphyotrichum ciliolatum	Lindley's Aster	
Symphyotrichum eatonii	Eaton's Aster	
Symphyotrichum ericoides var. *pansum*	Tufted White Prairie Aster	
Symphyotrichum spathulatum var. *intermedium*	Western Mountain Aster	
Symphyotrichum spathulatum var. *spathulatum*	Western Mountain Aster	
Symphyotrichum subspicatum	Douglas' Aster	
Tamarix parviflora	Smallflower Tamarisk	
Taraxacum erythrospermum	Red-seeded Dandelion	
Taraxacum officinale	Common Dandelion	
Tetradymia canescens	Grey Horsebrush	
Thalictrum occidentale	Western Meadowrue	✓
Thalictrum venulosum	Veiny Meadowrue	
Thinopyrum intermedium ssp. *barbulatum*	Hairy Wheatgrass	
Thinopyrum ponticum	Tall Wheatgrass	
Thlaspi arvense	Field Pennycress	
Torreyochloa pauciflora	Weak False-manna	
Toxicodendron rydbergii	Poison Ivy	
Tragopogon dubius	Yellow Salsify	

Taxon	Common Name	First Nations Use
Trifolium dubium	Small Hop-clover	
Trifolium hybridum	Alsike Clover	
Trifolium pratense	Red Clover	
Trifolium repens	White Clover	
Triglochin maritima	Seaside Arrow-grass	
Typha latifolia	Common Cattail	✓
Urtica dioica	Stinging Nettle	✓
Urtica dioica ssp. *gracilis*	Stinging Nettle	✓
Utricularia macrorhiza	Greater Bladderwort	
Verbascum thapsus	Great Mullein	
Veronica beccabunga var. *americana*	American Speedwell	
Veronica peregrina var. *xalapensis*	Purslane Speedwell	
Vicia americana	American Vetch	
Viola adunca var. *adunca*	Early Blue Violet	
Viola canadensis var. *rugulosa*	Canada Violet	
Viola nephrophylla	Northern Bog Violet	
Viola palustris var. *palustris*	Marsh Violet	
Viola vallicola var. *major*	Yellow Sagebrush Violet	
Woodsia oregana ssp. *oregana*	Western Cliff Fern	✓
Woodsia scopulina	Mountain Cliff Fern	
x Elyhordeum macounii	Macoun's Wildrye	
Zannichellia palustris	Horned Pondweed	
Zigadenus venenosus	Meadow Death-camas	✓
<u>Mosses</u>		
Amblystegium varium	[no common name]	
Barbula convoluta	Lesser Bird's-Claw Beard-Moss	
Brachythecium albicans	Lawn Moss	
Bryum argenteum	Silver Moss	
Bryum caespiticium	Tufted Thread-Moss	
Bryum pseudotriquetrum	[no common name]	
Bryum sp.	[no common name]	
Ceratodon purpureus	Fire Moss	
Coscinodon calyptratus	Steppe Mouse-Moss	
Cratoneuron filicinum	[no common name]	
Dicranum elongatum	[no common name]	
Dicranum scoparium	[no common name]	
Dicranum tauricum	[no common name]	
Didymodon australasiae	Didymodon Moss	
Didymodon vinealis	Wine-Coloured Beard-Moss	
Encalypta rhaptocarpa	Ribbed Snuffer Moss	
Funaria hygrometrica	Common Cord-Moss	
Grimmia anodon	Toothless Grimmia	
Grimmia longirostris	[no common name]	

Taxon	Common Name	First Nations Use
Grimmia pulvinata	[no common name]	
Homalothecium aeneum	Golden Curl-Moss	
Homalothecium nevadense	Nevada Curl-Moss	
Hylocomium splendens	Step Moss	
Hypnum revolutum var. *revolutum*	Roundabout Clawmoss	
Mnium thomsonii	[no common name]	
Orthotrichum speciosum var. *speciosum*	[no common name]	
Platydictya jungermannioides	[no common name]	
Pleurozium schreberi	Red-stemmed Feathermoss	
Pohlia sp.	[no common name]	
Polytrichum juniperinum	Juniper-Leaf Haircap Moss	
Polytrichum piliferum	Long-Awned Haircap Moss	
Pterygoneurum kozlovii	Alkaline Wing-nerved Moss	
Pterygoneurum ovatum	Egg-Leaf Wing-Nerved Moss	
Pterygoneurum subsessile	Stubby Wing-Nerved Moss	
Rhizomnium pseudopunctatum	[no common name]	
Rhytidiadelphus triquetrus	[no common name]	
Schistidium apocarpum	Common beard-moss	
Stegonia latifolia var. *pilifera*	Stegonia Moss	
Syntrichia caninervis	Syntrichia Moss	
Syntrichia ruralis	Sidewalk Moss	
Timmia megapolitana	[no common name]	
Tortula acaulon	[no common name]	
Tortula atrovirens	[no common name]	
Tortula brevipes	[no common name]	
Trichostomopsis australasiae	Witch Fists	
Liverworts		
Ptilidium pulcherrimum	Common Talus Wort	
Ricciocarpus natans	Purple-Fringed Water-Riccia	
Lichens		
Acarospora bullata	Cobblestone	
Acarospora fuscata	Trampled Cobblestone	
Acarospora glaucocarpa	Limey Cobblestone	
Alectoria sarmentosa	Witch's Hair	
Arthonia edgewoodensis ined.	Dot Lichen	
Arthonia xerophila ined.	Dust Lichen	
Aspicilia contorta	Chiseled Cinders	
Bryoria capillaris	Gray Horsehair	
Bryoria fremontii	Edible Horsehair	✓
Bryoria fuscescens	Pale-Footed Horsehair	
Bryoria tortuosa	Inedible Horsehair	
Buellia elegans	Elegant Soil Button	
Buellia griseovirens	Cindery Button	

Taxon	Common Name	First Nations Use
Buellia punctata	Simple Button	
Byssobilimbia beringeriana comb. ined.	[no common name]	
Calicium glaucellum	Silver-crown pin	
Calicium trabinellum	Golden-Crown Pin	
Calicium viride	Common Pin	
Caloplaca ammiospila	Tarnished Firedot	
Caloplaca flavorubescens	Exuberant Firedot	
Caloplaca holocarpa sensu lato	Sensible Firedot	
Caloplaca tominii	Footstep Firedot	
Caloplaca trachyphylla	Banged-Up Firedot	
Candelaria concolor	Elfin Candleflame	
Candelariella antennaria	Simple Peep	
Candelariella rosulans	Fringe Peep	
Candelariella vitellina	Wax Peep	
Cetraria ericetorum ssp. *reticulata*	Hyphenated Icelandmoss	
Cladina arbuscula ssp. *beringiana*	Mesomorphic Reindeer	
Cladina rangiferina	Gray Reindeer	
Cladonia cariosa	Lesser Ribbed Pixie	
Cladonia cenotea	Singing Pixie	
Cladonia coniocraea	Mama Littlehorn Pixie	
Cladonia cornuta	Bighorn Pixie	
Cladonia gracilis ssp. *turbinata*	Bronzed Pixie	
Cladonia macilenta	Lipstick Pixie	
Cladonia macrophyllodes	Low-Rise Pixie	
Cladonia multiformis	Shape-Shifting Pixie	
Cladonia pleurota	Mind-Altering Pixie-Cup	
Cladonia pyxidata	Pebbled Pixie-Cup	
Cladonia stricta	Lesser Pied Pixie	
Cladonia subulata	Antlered Pixie	
Cladonia sulphurina	Extra Hot Pixie	
Cladonia uncialis	Thorn Pixie	
Coelocaulon aculeatum	Spiny Heath	
Collema crispum	Ten-Cent Tarpaper	
Collema fuscovirens	Cellulitic Tarpaper	
Collema tenax	Tarred Tarpaper	
Dermatocarpon leptophyllodes	Jigsaw Stippleback	
Dermatocarpon miniatum	Blushing Stippleback	
Dimelaena oreina	Glowing Mosaic	
Diploschistes muscorum	Cowpie Lichen	
Flavocetraria nivalis	Ballroom Dervish	
Fulgensia bracteata	Goldnugget Sulphur	
Fuscopannaria praetermissa	Thumbs-Up Crackers	
Hypocenomyce scalaris	Common Char-Clam	

Taxon	Common Name	First Nations Use
Hypogymnia imshaugii	Forking Bone	
Hypogymnia physodes	Monk's Hood	
Hypogymnia wilfiana	Deflated Bone	
Lecania dubitans	Aspen Chalk	
Lecanora albellula	Bottlecap Rim	
Lecanora cf. farinaria	Milkpowder Rim	
Lecanora densa	Crowded Rim	
Lecanora flowersii	Flower's Rim	
Lecanora laxa	Lazy Rim	
Lecanora mughicola	Partly-Cloudy Rim	
Lecanora muralis	Wall Rim	
Lecanora pulicaris	Harlequin Rim	
Lecanora rugosella	Boiling Rim	
Lecanora rupicola	Snowy Rim	
Lecanora zosterae	Detritus Rim	
Lecidea atrobrunnea	Common Brown Tile	
Lecidella euphorea	Tarnished Jump-Rope	
Lecidella stigmatea	Salt-And-Pepper Jump-Rope	
Lepraria incana sensu lato	Common Dust Lichen	
Leptogium lichenoides	Tattered Vinyl	
Letharia vulpina	Valley Wolf	✓
Melanelia sorediata	Star-Studded Rockleather	
Melanelixia subaurifera	Abrading Camouflage	
Melanohalea exasperatula	Lustrous Camouflage	
Microcalicium subtile	Bleaching Pin	
Neofuscelia subhosseana	Erupting Toad	
Nephroma parile	Powdered Paw	
Nodobryoria abbreviata	Goodlooking Readhead	
Nodobryoria oregana	Mountain Readhead	
Ochrolechia upsaliensis	Open-Ground Donut	
Ophioparma rubricosa	Golddust Bloodspot	
Parmelia saxatilis	Pebbled Crottle	
Parmelia sulcata	Hammered Crottle	
Parmeliopsis ambigua	Green Starburst	
Parmeliopsis hyperopta	Grey Starburst	
Peltigera aphthosa	Silver-Edge Pelt	
Peltigera canina	Felt Pelt	
Peltigera malacea	Apple Pelt	
Peltigera ponojensis	Pale-Belled Pelt	
Peltigera praetextata	Born-Again Pelt	
Peltigera rufescens	Black-Bellied Pelt	
Peltula euploca	Powder-Lined Rock-Olive	
Phaeophyscia decolor	Lesser Eye Shadow	

Taxon	Common Name	First Nations Use
Phaeophyscia orbicularis	Powder-Headed Shadow	
Phaeophyscia sciastra	Midnight Shadow	
Phaeorrhiza nimbosa	Halloween Cupcake	
Physcia adscendens	Hooded Rosette	
Physcia caesia	Blue-Headed Rosette	
Physcia dubia	Grinning Rosette	
Physcia phaea	Black-Eyed Rosette	
Physconia enteroxantha	Gilded Frost	
Physconia muscigena	Ground Frost	
Physconia perisidiosa	Smirking Frost	
Placidium squamulosum	Rooted Soil-Beggers	
Placynthiella uliginosa	Duff Sizzle	
Platismatia glauca	Ragbag	
Porpidia crustulata	Concentric Boulder-Dot	
Porpidia macrocarpa	Huge Boulder-Dot	
Psora cerebriformis	Brain Pennies	
Psora decipiens	Red-Hot Pennies	
Psora globifera	Melted Pennies	
Psora tuckermanii	Rusty Pennies	
Rhizocarpon geminatum	Common Grey Map	
Rhizoplaca chrysoleuca	Pink-Eyed Rockbright	
Rhizoplaca melanophthalma	Green-Eyed Rockbright	
Rinodina roscida	Dry-Land Pepperspore	
Staurothele drummondii	Drummond's Blackhead	
Stereocaulon tomentosum	Eyed Foam	
Thelomma ocellatum	Granulating Guano Pots	
Trapeliopsis granulosa	Common Froth	
Tuckermannopsis chlorophylla	Silver-Lined Wrinkle	
Tuckermannopsis orbata	Shape-Shifting Wrinkle	
Tuckermannopsis platyphylla	Crinkled Wrinkle	
Umbilicaria americana	Frosted Rocktripe	
Umbilicaria hyperborea	Blistered Rocktripe	
Usnea lapponica	Powder-Ringed Beard	
Vulpicida canadensis	Brown-Eyed Sunshine	
Xanthomendoza fallax	Nested Sunburst	
Xanthomendoza fulva	Skeptical Sunburst	
Xanthomendoza mendozae	Hooded Sunburst	
Xanthoparmelia coloradoensis	Colorado Rockfrog	
Xanthoparmelia plittii	Plitt's Rockfrog	
Xanthoparmelia wyomingica	Barely Hopping Rockfrog	
Xanthoria candelaria	Shrublet Sunburst	
Xanthoria elegans	Elegant Sunburst	
Xanthoria polycarpa	Pincushion Sunburst	

Taxon	Common Name	First Nations Use
Xylographa parallela	Common Woodscript	

* B=Blue-list, R=Red-list, Y=Yellow-list

APPENDIX 9 WILDLIFE SPECIES ACCOUNTS

SPECIES - HABITAT MODEL - Badger

This model was originally prepared for the Nicola-Similkameen Innovative Forest Practices Society (Merritt Forest District), by T. Kyle Simpson. It has been updated and modified for the Ajax study area.

Species data

Common Name: Badger

Scientific Name: *Taxidea taxus*

Species Code: M-TATA

Provincial Status: Red-listed (BC CDC 2014)

Identified Wildlife Status: None

SARA Status: Schedule 1 Endangered (BC CDC 2014)

Project data

Area: Ajax TEM Mapping Area

Project Map Scale: TEM, 1:20,000

Ecoprovince: Southern Interior

Ecoregion: Thompson-Okanagan Plateau

Ecosection: Thompson Basin (THB)

Biogeoclimatic Zones: BGxh2, BGxw1, PPxh2, IDFxh2

1. DISTRIBUTION

The badger is widely, although perhaps unevenly distributed across the western and north-central United States. The range extends northward into western Canada and Ontario, and southward into central Mexico and Baja California (Messick 1987).

There are three subspecies of badger in Canada; *Taxidea taxus jeffersonii* occurs in British Columbia (Cannings 1999), *T. t. taxus* occurs in Alberta to Manitoba, and *T. t. jacksoni* occurs in southern Ontario (Messick 1987).

There is considerable overlap in the ranges of subspecies, with intermediate forms occurring in the areas of overlap. Badgers are undergoing range extensions eastward through escape or release of captive animals, and because of changes in agricultural patterns (Long 1983).

1.2 Provincial Range

Badgers occur in the Okanagan and Similkameen Valleys, Thompson River, Nicola Valley, and East Kootenay areas; a few badgers have been noted in the South Cariboo, West Kootenay and eastern Chilcotin (Blood 1995). The Thompson / Okanagan Badger Project observed badgers in the following regions; Boundary, Similkameen, South Okanagan, North Okanagan/Shuswap, Nicola, South Thompson, North Thompson, Cariboo, and Kootenays (Weir et al. 2001).

1.3 Distribution on the Study Area

The badger is expected to occur at low densities within suitable grassland, dry forest and roadside habitat throughout the LSA. Hoodicoff (1998) reported a radio-collared male badger using the area around Jacko Lake. Badger burrows have been sighted throughout the grassland areas of the LSA during field-truthing.

1.4 Elevation Range

In British Columbia, badgers occur from 400 to 1500 metres, and occasionally up to 2400 metres (Rahme 1995). The continental altitudinal distribution can extend from below sea level (Death Valley) to elevations higher than 3660 m (Long 1973).

2. ECOLOGY AND HABITAT REQUIREMENTS

2.0 General

The badger is at risk in British Columbia because the amount of suitable habitat for this species is small and has been adversely affected by human activity (Blood 1995). The badger has “Red” status in British Columbia, meaning that the species is considered threatened or endangered (Cannings et al. 1999). Large home ranges, declining populations, loss of habitat and prey, and potential for high mortality from roadkills and shooting are the principal reasons for this listing (Apps and Newhouse 2000; Nagorsen and Dyer 2011). Kinley and Newhouse (2008) suggested that prey availability (especially ground squirrels), roadkill mortality and landscape connectivity were the prime influences on badger distribution on their study area in the Kootenays.

A review of badger abundance in British Columbia in 1990 concluded that only 300 to 1000 animals likely occurred (Rahme 1995). There is a lack of habitat data for the badger in BC, as the first telemetry-based research program in the province was done in the East Kootenays by Newhouse (Apps and Newhouse 2000; Newhouse 1999; Newhouse and Kinley 2000). The diet and ecology of the badger has been well researched in Idaho (Messick and Hornocker 1981), Utah (Lindzy 1978), Iowa (Snead and Hendrickson 1942), and Minnesota (Lampe 1982). Knowledge of specific habitat requirements for the badger within the southern interior of BC is lacking.

Badgers in western North America are closely associated with open dry grasslands with deep friable soils that are suitable for excavating burrows (Rahme et al. 1995). Badgers also use open dry forests, such as ponderosa pine and mixed Douglas-fir with ponderosa pine (Stevens and Lofts 1988). Badgers do not appear to require grassland or open pine forests, but they probably prefer them and may attain higher densities in open habitats (Rahme et al. 1995). Badgers have been sighted in both grassland and non grassland landscapes within the Thompson / Okanagan (Weir et al, 2000). Weir also states that badgers may be able to exist in forested areas if the overall matrix of the area contains small patches of grassland. Badgers will also use cultivated lands and rural roadsides if prey is available (Blood 1995). Badgers in the Thompson / Okanagan study appeared to use areas of high human development - 50% of the tagged animals died on highways during July and August 2000 (Weir et al. 2001).

Much of badger food/prey tends to have the highest density in open areas such as preferred prey items of marmots, ground squirrels, and pocket gophers (Kinley and Newhouse 2008; Rahme et al. 1995; Lampe 1982). Badgers in the Thompson region have been noted to forage on yellow-bellied marmots (*Marmota flaviventris*), Columbian ground squirrels (*Spermophilus columbianus*), western rattlesnakes (*Crotalus oreganus*), northern pocket gophers (*Thomomys talpoides)*, Great Basin pocket mice *(Perognathus parvus)*, birds, and insects (Weir et al. 2000).

Habitat used by badgers in the Thompson/Okanagan study was mainly cultivated fields followed by grasslands and right-of-ways. Ponderosa pine and Douglas-fir forests, uban and industrial areas and banks were all used in minor amounts (Weir et al. 2001).

2.1 Home Ranges

Badgers are sedentary; for most of their lives, they remain in the same home range (Rahme et al. 1995). Juveniles without a permanent home area move erratically and sometimes travel long distances as they disperse from their natal areas (Messick 1987). They can move up to 110 km from their natal area after weaning during the first summer (Messick and Hornocker 1981). Home ranges of badgers vary in size according to sex, season, habitat quality, population density, and availability of prey (Rahme et al. 1995). Males use larger home ranges than do females, and the home ranges of males and females overlap, especially during the breeding season (Messick and Hornocker 1981). Because badgers reduce their activity during winter, especially in the northern part of their range and in alpine areas, their winter home ranges are a fraction of the area of their summer ranges (Rahme et al. 1995). The Thompson / Okanagan study recorded badgers staying in the same burrow without emerging for several months (Weir et al. 2001).

Sargeant and Warner (1972) radiotracked a female badger in Minnesota from late July to early January. Her total home range encompassed 850 ha. This badger also seasonally adjusted her range. For example, she occupied 761 ha between late July and September, 53 ha between October and November, and further reduced her activity during winter (December to mid-January). Her winter movements centred around a single den and were confined to a densely wooded 2 ha area. She remained underground for periods of several days.

In the East Kootenay, home range size was 5 to 270 times larger than any previously reported in the literature. While the proportion of home range that was "habitat" declined with increasing home range size, the absolute amount of home range that was habitat was positively correlated to home range size (Newhouse and Kinley 2000). This observation may be due to dispersed prey base, less area of treeless habitat, or limitations due to mortality and low fecundity (Newhouse and Kinley 2000).

Although sizes of badger home ranges in BC are not well known, they are likely between 100 ha and 500 ha (Rahme et al. 1995). Ritcey et al. (1988) indicated that 800 ha per badger is required in summer to meet feeding and reproductive needs. Home ranges of badgers within the Thompson / Okanagan varied considerably. The average range of males was 108.6 km^2 while a female and kit had a summer home range of 8.1 km^2 (Hoodicoff 1998). Although ranges of males were quite large, their movements seemed to be concentrated in distinct high-use areas (Weir et al. 2001).

2.2 Denning

Dens play a central role in the ecology of badgers, serving for daytime resting, food storage, birth sites, and headquarters for hunting forays (Blood 1995). Burrows are used for dens, escape and predation (Long 1973). Badgers live in or close to burrows during the day (Cowan and Guiguet 1965). Most dens had a single entrance (Lindzey 1976) with a large mound of freshly dug soil in front. When occupied, the den entrance was generally partially plugged with loose soil (Sargeant and Warner 1972). Most dens are used only once for resting and appeared similar to many other burrows that were dug apparently for feeding (Sargeant and Warner 1972). Some dens were reused on numerous occasions by the same badger, which suggests a knowledge of the location of the den (Lindzey 1982). In the East Kootenay study, badgers used old burrows at least twice as many times as they dug new ones (Newhouse and Kinley 2000). Natal dens in Utah had the following characteristics: a main tunnel that branched into two secondary tunnels which later rejoined; dead-end side tunnels that projected from the main tunnel, secondary tunnels, and chambers; pockets less than fifteen centimetres in length in the sides of tunnels and chambers; shallow excavations in the floors of tunnels; and chambers (Lindzey 1976).

3.0 HABITAT USE - LIFE REQUISITES

As described earlier, badger home ranges vary from a few square kilometres to hundreds of kilometres. There seems to be no distinction in habitat preferences throughout the year, although their movements are restricted during the winter months. Therefore, ratings will be provided for year-round habitat.

3.1 Living During All Seasons

Food

Badgers are predators that are proficient at hunting fossorial and semi-fossorial prey (Messick 1987), and can adjust their food habits to prey availability (Rahme et al. 1995). The badger diet consists mainly of burrowing rodents like ground squirrels, pocket gophers and marmots (Kinley and

Newhouse 2008; Hoodicoff 1998). Animals that take refuge in burrows, such as snakes and chipmunks, are also eaten (Blood 1995). Badgers are opportunistic and may supplement their diet with fish, reptiles, amphibians, birds and their eggs, invertebrates, carrion, corn and other grains, as well as herbs and wild grasses when normal prey availability is low (Rahme et al. 1995). Badgers may be attracted to roads, as disturbed soils appear to support higher ground squirrel densities (Ketcheson and Bauer 1995). Badgers will also eat road kills, so the preference for habitat close to paved roads might be partially a result of an attraction to carrion (Newhouse 1999).

Badger hunt primarily at night and are highly exploratory when foraging for fossorial prey (Messick and Hornocker 1981). Their highly-developed sense of smell is used to find potential prey (Blood 1995). Badger hunting tactics include chase and underground ambush techniques (Rahme et al. 1995). These tactics may include visiting old den sites where prey species may take refuge or plugging almost all burrow entrances and excavating the remaining entrance (Knopf and Balph 1969).

In the East Kootenay study (Newhouse and Kinley 2000), badger burrows were found in association with ground squirrel holes (77%). These areas were generally non-forested or with low crown closures (<46%), with moderately coarse to medium soil textures on glaciofluvial, glaciolacustrine or morainal parent materials (Newhouse and Kinley 2000).

Security and Thermal Habitat

Security habitat is defined as open grasslands for sight lines with friable soil and scattered dens for escape. Mortality in many areas appears largely caused by people (Kinley and Newhouse 2008), but deaths caused by other factors may go easily undetected (Lindzey 1982). The badger is an aggressive animal and has few natural enemies (Sullivan 1996). There are reports of predation on badgers by Golden Eagles, coyotes (Long 1973), cougars, and bobcats (Skinner 1990). Bears and grey wolves occasionally kill badgers (Lindzey 1982). Messick (1981) listed the major causes of badger deaths in southwestern Idaho as automobiles, control by farmers, indiscriminate shooting, and fur trapping.

The major requisite for den building is the friability of soils. Badgers may therefore avoid extremely rocky soils or soils that otherwise limit digging (Messick 1987). Badgers appear to select moderately coarse-textured surface soils (silty loam and sandy loam) on glaciofluvial parent material (Newhouse 1999). Ketcheson (1994) hypothesized that fluvial, glaciofluvial, lacustrine or morainal terrain with less than 20% coarse fragments and a cohesive, yet friable, fine fraction is an important habitat attribute. Apps and Newhouse (2000) found that soil texture, gravel component and drainage were not good predictors of badger habitat quality. Although wetlands themselves are not suitable for den sites, badgers have often been observed denning along the edges of wetlands and ponds (R. Klafki, pers. comm.).

Hoodicoff (1998) found that most badger burrows in the Thompson region were dug in areas with microtopographic relief (i.e. roadside berms), on sites dominated by grasses and low shrubs. Forested areas and riparian areas were avoided. Burrows were often located on sites with glaciolacustrine and lacustrine soils, but parent material differed significantly between burrow sites and random locations for only two of six animals. Large variations in individual habitat use precluded development of a predictive habitat model from that study, but badgers appeared relatively tolerant of human disturbance.

Badgers enlarge hunting burrows for concealment, protection from weather, and as natal dens; burrows are up to ten metres long and three metres deep (Sullivan 1996). Badger holes, the most prominent sign of this animal, have entrances 20 to 30 cm in diameter and are elliptical in shape, as one would expect from such a flattened animal (Blood 1995). Natal dens have several tunnels and separate chambers (Bryan and Mulholland 1992). The dens may persist for two or three years and be re-used several times by the same badger.

Winter is a difficult time for badgers. Rodents are less abundant than at their summer population peak, and the burrowing species are deep in hibernation dens. Badgers compensate for this prey scarcity by greatly reducing their movements and by staying in burrows for long periods to reduce heat loss. During cold spells, badgers may enter a state of mild torpor characterized by a slowed heart beat and reduced body temperature (Harlow 1981). This topor is not true hibernation, and is unusual in the weasel family (Blood 1995).

4.0 RATINGS

There is an intermediate level of knowledge regarding the habitat requirements of the badger in British Columbia, so a 4-class ratings scheme was used (Table 1). Badger habitat will be rated for Living (LI) in All (A) seasons.

Table 1. Habitat Capability and Suitability 4-Class Rating Scheme (from RIC 1999).

% of Provincial Best	Rating	Code
100% - 76%	High	H
75% - 26%	Moderate	M
25% - 1%	Low	L
0%	Nil	N

4.1 Provincial Benchmark

A provincial benchmark has not been identified for the badger at present. Badgers occur primarily in the dry southern interior valleys that support grassland, shrub-steppe, and open stands of ponderosa pine or Douglas-fir (Blood 1995). The best habitat would consist of grasslands or open pine forests with friable soil to dig in and abundant prey. The best areas within BC are the South Okanagan and East Kootenays (Rahme et al. 1995). The best biogeoclimatic zones are the BG and PP. The most suitable broad ecosystem units are the shrub-steppe or grassland types .

4.2 Assumptions

Ritcey et al. (1988) rated the bunchgrass grassland habitat as having high value to badgers for both feeding and reproductive requisites, while various stages of other biogeoclimatic zones have medium, low, or no value to badgers. The grass/forb stage of big sage shrub/grassland, ponderosa pine and Douglas-fir/ponderosa pine habitats have medium value. Within the forested sites, those with dry (Fd, Lw, Py) or mesic (Pl, Sxw) conifer species leading were rated the best (Newhouse 1999).

Badgers prefer open areas, so structural stage 2 (grassland/forb) was given the highest ratings. Site series with medium to fine soil textures, with glaciofluvial parent materials, and rich nutrient regimes were rated the highest. Flood-prone areas and those with shallow, rockyor wet soils were given low ratings.Assumptions are summarised in Table 2.

Table 2. Assumptions for habitat use by badgers in the Ajax study area.

Attribute	Value	Maximum Rating
Subzone	IDFxh, PPxh, BG	H
Structural Stage	2 and 3	H
	4	L
	5, 6, and 7	M
Ecosystem	Moist to mesic coniferous forest, big sage shrublands, cultivated field	M
	Grasslands	H
	Waterbodies, wetlands, mines, road, gravel pit, urban, rural, wetter-than-mesic ecosystems, deciduous forest, exposed soil, rock, talus, cutbank	N
Ecosystem modifier	Shallow soils (v, s)	L
Parent Material	Morainal, Glaciofluvial, and Glaciolacustrine	H
	Fluvial, Eolian, Lacustrine	M
	Colluvial and Rock	L

4.3 Rating Adjustments

The following adjustments should be made based upon bioterrain attributes:

- Morainal, Glaciofluvial, and Glaciolacustrine surficial materials rated up to class H.
- Fluvial, Eolian, Lacustrine surficial materials rated up to class M

- Colluvial, Weathered Bedrock, Volcanic and Rock surficial materials rated up to class L.
- Sites with shallow soil (v, x surface expression codes) rated up to class L.

Polygons rated M-L that are adjacent to wetlands or waterbodies (OW, PD, LA) should be upgraded by one class (R. Klafki, pers. comm.).

4.4 Confounding Factors and Reliability Qualifier

Badgers are wide-ranging carnivores with documented wide variation in habitat use. Therefore, this model is assessed as having only moderate reliability.

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SPECIES - HABITAT MODEL - Great Basin Pocket Mouse

This model was originally prepared for the Nicola-Similkameen Innovative Forest Practices Society (Merritt Forest District), by Lower Nicola Indian Band and edited by Les Gyug, Okanagan Wildlife Consulting. It has since been updated and modified for the Ajax study area.

Species Data

Common Name:	Great Basin Pocket Mouse
Scientific Name:	*Perognathus parvus*
Species Code:	M_PEPA
Provincial Status:	Red-listed (BC CDC 2014)
Identified Wildlife Status:	None
COSEWIC Status: (COSEWIC 2014)	Not currently listed on the COSEWIC Candidate Species List

Project Data

Area:	Ajax TEM Mapping Area
Project Map Scale:	TEM, 1:20,000
Ecoprovince:	Southern Interior
Ecoregion:	Thompson-Okanagan Plateau
Ecosection:	Thompson Basin (THB)
Biogeoclimatic Zones:	BGxh2, BGxw1, PPxh2, IDFxh2

1. DISTRIBUTION

The Great Basin pocket mouse occurs in the Columbia River and Great basins and adjacent lands (Verts and Kirkland 1988). It is distributed from south-central British Columbia and eastern Washington south to southeastern California, Nevada, and northern Arizona and east to southeastern Montana and Wyoming.

1.1 Provincial Range

A discontinuous range occurs in the south and north Okanagan Valley, the lower Similkameen Valley, and the Thompson and Kettle valleys (Nagorsen 2004). The northern periphery of the Great Basin pocket mouse's range is the dry southern interior Thompson River Valley (Ashcroft to Kamloops), and the Okanagan Valley near Vernon (Nagorsen 2005). It occupies the PP, BG and IDF BEC zones (BC CDC 2014).

1.2 Elevation Range

Up to 1370 m in the south Okanagan (Iverson 1967).

1.3 Distribution on the RSA

The Great Basin pocket mouse has only been recorded a few times in the Thompson valley near Kamloops, and has not been found there since 1949 (Nagorsen 2005).

2.0 ECOLOGY AND HABITAT REQUIREMENTS

2.1 General

"The Great Basin pocket mouse is a mouse-like rodent with a long tail (longer than the head and body combined), soft, sleek pelage, small ears, and external fur-lined cheek pouches. The dorsal pelage is dull grey-brown and the undersides pure white." (Nagorsen 2005). Average head and body length in BC is 83 cm, average tail length is 93 mm, and average weight is 21 g for males, and 19 g for females (Nagorsen 2005).

Two subspecies occur in British Columbia- *Perognathus parvus laingi* and *P. p. lordi* (Nagorsen 2004). They represent low elevation and high elevation/northern populations in British Columbia. Subspeciation is based on variations in life history strategies, size, and colour but Iverson (1967) found little support for recognition of the two subspecies.

2.2 Diet and Foraging Behaviour

Great Basin pocket mice are nocturnal, foraging on green leaves, buds, seeds, and occasionally invertebrates (Verts and Kirkland 1988). They spend as little time as possible above ground, limiting their activity to the essentials of food gathering and breeding (O'Farrell et al. 1975). Pocket mice (*Perognathus* spp.) are scatterhoarders: they cache seeds in shallow depressions and cover the seeds with soil. The seeds are primarily those of grass and forb species (Verts and Kirkland 1988). Indian ricegrass (*Oryzopsis hymenoides*), cheatgrass (*Bromus tectorum*), antelope brush (*Purshia tridentata*), pigweed (*Amaranthus* spp.), and mustard (*Brassica* spp.) seeds are particularly important ((Jenkins and Ascanjo 1993; see review by Verts and Kirkland 1988).

Although Great Basin pocket mice consume primarily seeds, they also eat some green vegetation. Prior to production of seeds, they consume insects (Verts and Kirkland 1988). Great Basin pocket mice satisfy water requirements by metabolizing water from food (Verts and Kirkland 1988) and thus do not require free water.

Estimated seed intake of a Great Basin pocket mouse is from 4 to 10 percent of total body weight daily (Schreiber 1968). Assuming a wholly cheatgrass diet, an individual requires 870 to 1,000 seeds per day in spring and summer, and about 750 seeds per day in fall. A total of about 50-60 g of seed must be cached to meet the winter energy requirement.

2.3 Reproduction

Great Basin pocket mice are reproductively active in the spring and summer (Verts and Kirkland 1988). Males emerge from their winter dormancy earlier than females. After females emerge, copulation takes place. The gestation periods lasts between 21 and 28 days. Females breed earlier at high elevations with pregnant females first observed in late May (Iverson 1967). At low elevations, pregnant females were not observed until early June. The breeding season ends in late July in the high elevation populations but extends until late August or early September at low elevations. Females give birth to 2 to 8 young. Female Great Basin pocket mice generally produce one or two litters. However, females at low elevations may produce up to three (Iverson 1967).

2.4 Denning

Tunnels are constructed that are about 25 mm in diameter (Verts and Kirkland 1988). Permanent burrows typically extend to a maximum depth of 1 m below the soil surface and have one or more storage chambers for seed, a nest cavity and several entrances. There are typically also escape burrows that area shallow (20-30 cm) lack nests and food caches, and have at least two entrances. Soils must be generally sandy and dry to facilitate digging of the burrows (Iverson 1967).

2.5 Dispersal and Movements

There is little information regarding territorial behaviour but Great Basin pocket mice invariably occupy separate nests in the wild (Verts and Kirkland 1988). Home ranges are very small—usually much less than 1 ha. Based on studies in the Okanagan Valley (Iverson 1967) reported home ranges were 656-895 m2. Home range size may vary among sexes. In one study in Washington, average home ranges were 0.31 ha and 0.15 ha for males and females respectively (Schreiber 1956). In another study in Washington, home range sizes in Washington ranged between 0.16-0.40 ha for males, and 0.05-0.23 ha for females (O'Farrell et al. 1975).

2.6 Densities

Iverson (1967) found high numbers in the South Okanagan in sandy soils in sagebrush and antelope brush habitat. Iverson (1967) found minimum numbers of 16-21 individual Great Basin pocket mice per 1-ha grid in June of 1964, and 30-44 from April-June 1965 in ideal (sandy) habitat on the east side of Osoyoos Lake. In less ideal, higher elevation, sagebrush habitat at Richter Pass, numbers ranged from 8-10 in June of 1964, and from 14-17 in April-May of 1965. Sullivan and Sullivan (2004) found them at densities of 15-25/ha in sagebrush habitats on fine-textured lacustrine soils near Summerland, and at densities of 2-8/ha in old fields and ponderosa pine forest.

Maximum densities outside of BC have been considered to be 80/ha as the maximum that could be supported by seed crops (Schreiber 1968), which was similar to the densities estimated by Gray (1943) and O'Farrell et al. (1975). Verts and Carraway (1998) estimated that there were 109/ha in the trapping conducted by Small and Verts (1983).

2.7 Hibernation and Torpor

Little above-ground activity occurs between November-March; during this time, long periods of torpor are alternated with periods of food consumption (Verts and Kirkland 1988). During periods of high temperatures, Great Basin pocket mice may enter into torpor to reduce heat-induced stress (Iverson 1967).

3. HABITAT USE – LIFE REQUISITES

The Great Basin pocket mouse is commonly associated with light sandy soils in arid and semi-arid regions (Verts and Kirkland 1988). The species is restricted to the dry grasslands of British Columbia, the Great Basin pocket mouse inhabits arid valley bottoms and open slopes on hillsides (Nagorsen 2005). Typical habitat is grassland and shrub-steppe with a shrub cover of antelope brush, big sage, and grasses such as bluebunch wheatgrass and needle-grass (Iverson 1967).

Sandy or light-textured soils are preferred (Feldhamer 1979) because they provide ideal conditions for excavating burrows. However, it has also been found among rocks, and on anthropogenic (old-field) grasslands dominated by introduced grasses (BC CDC 2012). At higher elevations the Great Basin pocket mouse is associated with pasture sage (*Artemisia frigida*, or common rabbit-brush (*Ericameria nauseosa*) habitats in clay till soil (Iverson 1967). Pocket mice will also use disturbed grasslands (grazed and burned) (Iverson 1967). Ponderosa pine and interior Douglas-fir forests are rarely used (Iverson 1967).

The life requisite of the Great Basin pocket mouse to be modeled is Living Habitat (LI), which includes habitats used for Feeding (FD), Security/Thermal (ST), Hibernating, and Reproducing (RB). The species lives in the same habitat year-round, usually in very small areas, therefore only Living habitat need be modeled, since all the requisites must be met in the same location.

Table 2. Life requisites for the Great Basin pocket mouse.

Life requisite	Habitat use	Months
Food	Living	April -Nov
Reproducing Habitat	Reproduction- Birthing	April-Aug
Security and Thermal Habitat	Torpor, Escape	April -Nov
Security and Thermal Habitat	Hibernating and Living off stored seed caches	Nov-April

4. RATINGS

There is an intermediate knowledge of the habitat requirements of Great Basin pocket mouse in British Columbia. A 4-class rating scheme will be used (RIC 1999; Table 3).

Table 3. Description of 4-Class Rating Scheme (RIC 1999).

% of Provincial Best	Rating	Code
100% - 76%	High	H
75% - 26%	Moderate	M
25% - 1%	Low	L
0%	Nil	N

4.1 Provincial Benchmark

Highest densities of this species occur in the south Okanagan and lower Similkameen valleys (Iverson 1967; Nagorsen 2004). Assumed benchmark densities are 20-40 mice per ha in sandy (coarse) valley bottom soils in sagebrush habitats in the south Okanagan valley. Sullivan and Sullivan (2004) found them at densities of 15-25/ha in sagebrush habitats on fine-textured lacustrine soils near Summerland. These are about half the maximum densities that occur further south in the Great Basin. As the Great Basin pocket mouse has not been recorded recently in the Kamloops area, the maximum possible rating will be Moderate on the LSA.

4.2. Assumptions

1. Fescue/bunchgrass grasslands in structural stage 2 or 3 will be rated up to Moderate in the BG and PP, and Low in the IDF.
2. Cultivated fields and giant wildrye grasslands will be rated a maximum of Low.
3. All other ecosystems and structural stages will be rated Nil.

4.3 Rating Adjustments

1. Sites not on lacustrine, fluvial, glaciofluvial or eolian soils should be downgraded to Nil.
2. Open (<25% canopy closure), mesic to dry ponderosa pine forests, and rock outcrop in all structural stages within 200 m of Moderate-rated grassland habitat will be upgraded from Nil to Low as per Table 4 below.

Table 4. Ecosystem units to upgrade to Low when within 200 m of Moderate-rated habitats.

Subzone	Ecosystem units to upgrade
BGxh	Ro01, Ro02, 02, 03
BGxw	Ro01, Ro02, 02.

4.4 Reliability Qualifier

Livetrap surveys using Longworth and Sherman traps were conducted in the regional study area during August 2008, at apparently suitable habitat in the BGxw1. Six transects were laid out, with 20 trap stations on each transect. Each station had one Longworth and one Sherman trap. Transects were trapped for two nights each, for a total of 480 trap-nights. No pocket mice were captured, although the habitat appeared suitable to a biologist experienced at trapping pocket mice in the Okanagan (M. Sarell, pers. comm.). Factors limiting pocket mouse populations in the Kamloops area are unknown). Therefore, the habitat model is given a reliability rating of Low.

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Personal Communications

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SPECIES - HABITAT MODEL - Columbian Sharp-tailed Grouse

This species account is based upon one originally prepared by Irene Teske, B.Sc., R.P.Bio. and Penny Ohanjanian, M.Sc., R.P.Bio., for the Premier Diorite Project. It has been edited and updated for the Ajax Project.

Species Data

Common Name: Columbian Sharp-tailed Grouse

Scientific Name: (*Tympanuchus phasianellus columbianus*)

Species Code: B-STGR-CO

Provincial Status: Blue-listed (BC CDC 2014)

COSEWIC Status: not listed (BC CDC 2014)

Identified Wildlife Status: Identified (BCMWLAP 2004)

Project data

Area: Ajax TEM Mapping Area

Project Map Scale: TEM, 1:20,000

Ecoprovince: Southern Interior

Ecoregion: Thompson-Okanagan Plateau

Ecosection: Thompson Basin (THB)

Biogeoclimatic Zones: BGxh2, BGxw1, PPxh2, IDFxh2

1.0 DISTRIBUTION

There are seven sub-species of Sharp-tailed Grouse in North America. The Columbian Sharp-tailed Grouse (CSTG) was originally found in the Great Basin and Columbia Plateau, from interior central and southern BC, Washington, Oregon, Idaho, and northwestern Montana to California, Wyoming and Nevada, east to Utah and southwestern Colorado (NRCS 2007; Tesky 1994). It is now extirpated from California (Hoffman and Thomas 2007), and currently occupies less than 5% of its original range (Utah DWR 2002).

1.2 Provincial Range

The Columbian subspecies occurs '*from near Vanderhoof south to Merritt, east to the Cariboo Mountains, and west to the Coast Ranges*' (BCMWLAP 2004). It has been extirpated from the Okanagan. CSTG occupy the Bunchgrass, Interior Douglas-fir, Montane Spruce, Ponderosa Pine, Sub-boreal Pine and Spruce and Sub-boreal Spruce BEC zones (BC CDC 2012). Within BC, about 42 sub-populations (lek groups and isolated leks) are known (D. Jury, pers. comm., cited in BC CDC 2012).

1.3 Distribution on the Study Area

CSTG were observed during lek surveys within the LSA. Active lek sites are located on private land within the TEM-mapped area (D. Jury, pers. comm.; Howie 2004) and additional lek sites may also be present. Hunting CSTG within Region 3 is currently permitted only in MU-3-31 (northwest of Clinton).

1.4 Elevation Range

- 275–1190 m in British Columbia (BC MWLAP 2004). In Utah, elevation ranges up to 2438 m have been reported (Utah DWR 2002).

2. ECOLOGY AND HABITAT REQUIREMENTS

The Sharp-tailed Grouse is a prairie game bird. The Columbian subspecies of Sharp-tailed Grouse is associated with native grasslands and perennial bunchgrasses, including bluebunch wheatgrass and rough fescue in excellent condition. Deciduous trees and shrubs are also considered essential habitat features (Ritcey 1995). Declines in CSTG populations across the subspecies' range have been associated with diminished quality and quantity of native grassland habitat, especially with conversion of native grassland and shrub-steppe to cropland, overgrazing, and forest encroachment onto grasslands (Schroeder et al. 2000; NRCS 2007; McDonald and Reese 1998).

High-suitability habitat for CSTG consists of a mosaic of grassland growing season range interspersed with shrubby riparian wintering habitat (USDA 1999). In the BC southern interior, CSTG are associated with climax grasslands with little to no sagebrush in the BG, PP and IDF (Leupin 2003). Sharp-tails in Utah (Evans 1968 cited in Tirhi and Hayes 1997) and Idaho (Marks and Marks 1987 cited in Tirhi and Hayes 1997) preferred slopes <60%, and Ritcey (1995) also states that the subspecies prefers gentle slopes.

CSTG do not migrate, but may make short-distance movements between winter and summer habitats when snowfall dictates. Home range size is influenced by topography, availability of food and cover, and season (Tirhi and Hayes 1997). Year-round home ranges in BC have been documented as averaging 4.9 km^2 (Van Rossum 1992 in BCMWLAP 2004). Two male birds in the Kamloops area had home ranges of 2.1 and 3.8 km^2 (Leupin 2000 cited in Leupin 2003). Near Kamloops, radio-marked males remained within 600 m of the lek (Leupin 2000 cited in Leupin 2003), and radio-marked birds of both sexes remained within 2.8 km of the lek of capture (Leupin 2003). In

Washington State, CSTG moved up to 14 km between breeding habitat and winter habitat (Schroeder 1994 cited in Tirhi and Hayes 1997).

CSTG feed mainly before sunrise and after sunset (USDA 1999). Approximately 90% of the diet is made up of vegetative matter (primarily forbs, fruits, buds and grasses), with insects forming the remaining 10% (USDA 1999; Hoffman and Thomas 2007). The diet of chicks is primarily insects (BCMWLAP 2004). Important food plants for grassland populations include snowberry (*Symphoricarpos alba*), rose (*Rosa* sp.), buttercup (*Ranunculus* spp.), salsify (*Tragopogon dubius*), chokecherry (*Prunus virginiana*), prickly lettuce (*Lactuca scariola*) and dandelion (*Taraxacum officinale*), and during the winter, buds and browse from water birch (*Betula occidentalis*), trembling aspen (*Populus tremuloides*), saskatoon (*Amelanchier alnifolia*), and chokecherry (BCMWLAP 2004; Hoffman and Thomas 2007; Jones 1966).

In late fall and winter, a short migration may occur to nearby deciduous riparian areas with well-developed shrub communities, which are critical components of winter habitat (Hoffman and Thomas 2007). This may occur in response to snow; one radio-collared grouse in northern Montana remained in native grassland habitat until a storm left 7 to 10 cm of snow on the ground, at which time (January) it moved to shrubby wintering habitat (Wood 1992). Sharp-tailed Grouse winter in mainly in shrublands, feeding on chokecherry, saskatoon, rose (*Rosa spp*.) and other shrubs (Marks and Marks 1987, 1988), and roosting on the ground or under deep snow (Hoffman and Thomas 2007; USDA 1999). Wintering habitat is critical, especially during heavy snowfall years. During mild winters, birds may remain on summer grassland habitat (NRCS 2007).

Sharptails aggregate into larger flocks on the wintering grounds (USDA 1999). Flocks documented in BC have ranged from 7-72 birds (Leupin 2003). There is some evidence that individual birds may return to traditional wintering areas (Hoffman and Thomas 2007).

In early spring (March to late June), males congregate on traditional dancing grounds (leks) in the open, where they perform displays of foot-stamping with wings outstretched, tails raised and heads lowered (Hoffman and Thomas 2007). Males display for 2-3 hours on leks every morning, beginning from 30 to 60 minutes before sunrise (NRCS 2007).The number of males on a single lek ranges from two to 35, with the more dominant males occupying favoured positions at the centre of the lek (NRCS 2007).Young and/or subordinate males may occupy smaller satellite leks on the periphery of the main lek (Schroeder et al. 2000). Females visit the lek to choose a mate. Most females visit leks in mid to late-April in BC (D. Jury, pers. comm. cited in Leupin 2003). Although the older central males are chosen by most of the females, yearling males are often successful at breeding (Bergerud 1988).

Males (and occasionally females) return to leks in the fall, possibly to establish hierarchies for the following breeding season or to allow juvenile birds to learn the location of the lek (Leupin 2003; Hoffman and Thomas 2007). Males generally remain within 2 km (often within 400 m) of the lek during the growing season (Hoffman and Thomas 2007). Male grouse and females that have not nested successfully spend the remainder of the growing season singly or in small groups (USDA 1999; Tirhi and Hayes 1997).

Males on leks appear to be tolerant of some forms of disturbance but are displaced by predators and by human presence (Leupin 2003). Nesting females in particular are susceptible to disturbance (BC CDC 2012). Females also avoid disturbed leks, which can affect overall reproductive success (Baydeck and Hein 1987, cited in BC CDC 2008b). Some sources state that physical, mechanical, and/or audible disturbances within a 2 km radius of leks can disturb courtship displays, breeding, nesting, and brood-rearing (NRCS 2007). Some anthropogenic disturbance, such as road traffic at a distance greater than 1 km, is unlikely to cause changes in habitat use, especially if security cover is present (D. Jury, pers. comm.).

Eggs are laid in shallow depressions on the ground under cover of a shrub or large bunchgrass in native grassland habitat (Hoffman and Thomas 2007). Nests are usually within 5 km of the dancing grounds. Giesen and Connelly (1993) reported that most females nested within 1.6 km of the lek at which they were trapped. In the Kamloops area, nests were located within 2400 m of the lek (Leupin 2003). Individual females may return to the same general nesting area in successive years (Hoffman and Thomas 2007).

In the southern interior of BC, clutches were found from May 5, with hatching to June 11, though nesting activity is known to be delayed during cold springs (Leupin 2003). One brood is raised per year, though most hens will re-nest if the first clutch is lost (BCMWLAP 2004; Hoffman and Thomas 2007; Ritcey 1995). Eleven eggs form the average clutch in BC (Leupin 2001 cited in Leupin 2003), which is incubated for 23 days before hatching (USDA 1999).

Chicks are precocial and only the female takes care of the brood, which depends on cover and cryptic coloration for protection. The young can fly at ten days of age (USDA 1999).The chicks are vulnerable to inclement weather, starvation and predators (Bergerud 1988 cited in Tirhi and Hayes 1997), so survival rates can be quite variable (BCMWLAP 2004). However, juvenile mortality rates in BC are unknown (Leupin 2003). Mortality of adult birds may be highest during spring and fall dancing periods and during periods of severe winter weather (Leupin 2003). Annual survival of sharptails in Washington State has been reported as 53% (Schroeder 1994 cited in Tirhi and Hayes 1997).

Hoffman and Thomas (2007) state that the primary threats to CSTG are "habitat loss and degradation caused by conversion of native habitats to pasture and croplands, overgrazing by domestic livestock, energy development, use of herbicides to control big sagebrush, alteration of natural fire regimes, invasion of exotic plants, and urban and rural expansion".

3.0 HABITAT USE - LIFE REQUISITES

The life requisite that will be rated for CSTG is "Living" in the growing season and in winter. For CSTG, "living" is satisfied by the presence of suitable feeding, and security/reproductive habitat as described in detail below.

3.1 Feeding and Security Habitat

Winter

Winter habitat is typically riparian or upland shrubs, including saskatoon, rose, hawthorn (*Crataegus douglasii*) and chokecherry (Hoffman and Thomas 2007). Wintering areas must provide thermal as well as forage values for this species. Suitable wintering habitat may include structural stages 2-7 (BC MWLAP 2004). Near Kamloops, wintering CSTG used shrub/tree habitats with trembling aspen, black cottonwood (*Populus balsamifera*), and Douglas-fir (*Pseudotsuga menziesii*) in the canopy, and water birch, chokecherry, common snowberry, saskatoon, red-osier dogwood (*Cornus stolonifera*) and prickly rose (*Rosa acicularis*) in the shrub layer (Leupin 2003). Open grassland habitats are still used when snow depths are minimal. Marshes and sedge fens may be used for snow roosting (Ritcey 1995).

Growing Season

Growing season habitat normally consists of structural stages 2 and 3 (BCMWLAP 2004). During the late summer and fall, sharptails may forage in grainfields where such crops are available (USDA 1999; Leupin 2003). Females with broods may use shrubby areas and aspen copses as brood-rearing areas, and tend to nest adjacent to suitable rearing habitat (Hoffman and Thomas 2007). Plant species present in the Kamloops area that have been associated with sharp-tail habitat are summarized in Table 1.

Table 1. Plants associated with CSTG habitat (from NRCS 2007; Hoffman and Thomas 2007).

Common Name	**Scientific Name**
bluebunch wheatgrass	*Pseudoroegneria spicata*
brome grasses	*Bromus* spp.
soopolallie	*Shepherdia canadensis*
bluegrass	*Poa* spp.
chokecherry	*Prunus virginiana*
clover	*Trifolium repens*
yarrow	*Achillea millefolium*
dandelion	*Taraxacum officinale*
salsify	*Tragopogon dubius*
gromwell	*Lithospermum* spp.
hawkweed	*Hieracium* spp.
saskatoon	*Amelanchier alnifolia*
willow	*Salix* spp.
juniper	*Juniperus* spp.
lamb's-quarters	*Chenopodium album*
rose	*Rosa* spp.
big sage	*Artemisia tridentata*
snowberry	*Symphoricarpos alba*
wheatgrass	*Elymus* spp.
thistle	*Cirsium* spp.
water birch	*Betula occidentalis*
arrowleaf balsamroot	*Balsamorhiza sagittata*
buckwheat	*Eriogonum* spp.
hawksbeard	*Crepis* spp.
lupine	*Lupinus* spp.
knotweed	*Polygonum* spp.
sedge	*Carex* spp.
prickly lettuce	*Lactuca serriola*
alfalfa	*Medicago sativa*
Idaho fescue	*Fescue idahoensis*

3.2 Reproducing-Eggs

Lek habitat consists of flat, bare or short-grass areas, often located on a ridge or hilltop (USDA 1999; Hoffman and Thomas 2007). Shrub cover on or adjacent to leks may offer escape cover from predators (Giesen and Connelly 1993). Leks may be re-used for many years (>40 years in BC; Leupin 2003), but the actual location may shift slightly from year to year, forming 'lek complexes' (Schroeder et al. 2000). New leks may be established occasionally by adult males (Tirhi and Hayes 1997). Leks must be secluded and well away from disturbance (BCMWLAP 2004). Size of CSTG leks ranges from 20 to >400 m^2 (Hoffman and Thomas 2007).

Suitable nesting habitat is considered a limiting factor for CSTG (Leupin 2003).Campbell et al. (1990) described nest sites as either in open grassland or under sparse canopies of lodgepole pine, ponderosa pine, Douglas-fir or trembling aspen. Nests located near Kamloops were found in dense grasses (bunchgrass, rough fescue, Kentucky bluegrass), averaging 36 cm in height (Leupin 2003). Another species of security value is arrowleaf balsamroot (*Balsamorhiza sagittata*), which is often found in association with rough fescue (*Festuca spp*.) or bluebunch wheatgrass (*Pseudoroegneria spicata*). Adults and broods are vulnerable to aerial and mammalian predators. Grass cover >25 cm in height seems to be characteristic of successful nesting habitat (BC MWLAP 2004). Nests are located in denser cover than the surrounding area (NRCS 2007). In Minnesota, nests are typically located in grass or adjacent to brush or stumps (USDA 1999). Heavy livestock grazing may reduce nesting cover below optimum (Ritcey 1995).

Habitat used by females with broods may differ from that used by nonbreeding adults (Tirhi and Hayes 1997). Brood-rearing habitat in the southern interior consisted of swales and seepage areas with shrubs and dense herb cover 60 cm in height, as well as aspen copses (Leupin 2003). Nesting and brood-rearing habitat on native grassland on the Tobacco Plains, Montana, was characterized by dense grass cover with an average effective height of >20 cm (Wood 1992). In Wyoming, CSTG broods used sagebrush-snowberry and mountain shrub habitat more than expected, and used edges of large openings rather than the centres (Klott and Lindzey 1990).

3.3 Seasons of Use

CSTG habitat will be rated for two seasons: the Growing season (May to October), and the Winter season, as the habitats required in these two seasons are markedly different. Table 2 summarizes the life requisites required for each month of the year.

Table 2. Seasons and life requisites for Columbian Sharp-tailed Grouse.

Month	Season	Life Requisites
Jan	Winter	Feeding/Security-thermal (Living)
Feb	Winter	Feeding/Security-thermal (Living)
March	Winter	Courtship, Feeding/Security-thermal (Living)
April	Winter	Courtship, Feeding/Security-thermal (Living)
May	Growing	Courtship, Feeding/Security (Living)
June	Growing	Reproducing-eggs (Living)
July	Growing	Reproducing-eggs (Living)
Aug	Growing	Feeding/Security-thermal (Living)
Sept	Growing	Feeding/Security-thermal (Living)
Oct	Growing	Feeding/Security-thermal (Living)
Nov	Winter	Feeding/Security-thermal (Living)
Dec	Winter	Feeding/Security-thermal (Living)

*Seasons defined for Southern Interior Mountains Ecoprovinces per the Chart of Seasons by Ecoprovince (RIC 1998, Appendix B).

3.4 Habitat Use and Ecosystem Attributes

Table 3 outlines how each life requisite relates to specific ecosystem attributes (e.g. site series/ecosystem unit, plant species, canopy closure, age structure, slope, aspect, terrain characteristics).

Table 3. Terrestrial ecosystem mapping (TEM) Relationships for each life requisite for Columbian Sharp-tailed Grouse.

Life Requisites	Description
Growing season Living/Reproducing-eggs	Native grasslands with perennial bunch grasses (fescue and/or bluebunch wheatgrass) in excellent condition (Structural Stage 2). • High profile vegetation (height 30 cm plus is excellent, 20 cm is minimal) remaining as residual from previous year. Shrubby areas with high diversity of vegetation and abundant insects for brood-rearing.
Winter Living	• Shrub and deciduous habitat, with abundant saskatoon, rose, chokecherry, aspen; structural stages 3-7; native grassland during low-snow periods

4.0 RATINGS

There is an intermediate level of knowledge on the habitat requirements of CSTG in British Columbia and thus, a 4-class rating scheme will be used (Table 4). Ratings will be provided for Living in the growing season (BSTGRCO_G) and Living in the winter (BSTGRCO_W).

Table 4. Description of 4-Class Rating Scheme (RIC 1999).

% of Provincial Best	Rating	Code
100% - 76%	High	H
75% - 26%	Moderate	M
25% - 1%	Low	L
0%	Nil	N

4.1 Provincial Benchmark

No provincial benchmark has been defined. According to the Kamloops MOE Regional Wildlife Biologist, habitat within the study area should be rated up to High (D. Jury, pers. comm. June 20, 2008).

4.2 Ratings Assumptions

Ratings assumptions are summarized in Tables 5 and 6 below. Growing season ratings have been based primarily on habitat suitability for Reproducing-eggs habitat (nesting and brood-rearing) rather than lek habitat (Hoffman and Thomas 2007).

Table 5. Assumptions for Living during the Growing Season

Variable	Value	Maximum Rating	Comments
BEC subzone	BG, IDF, PP	H	
Ecosystem Unit	Bunchgrass grasslands, riparian aspen, riparian cottonwood, riparian water birch, riparian mixed forest, water birch ecosystems	H	Nesting habitat, nonbreeding adult living habitat
	Sagebrush/rabbitbrush grasslands, non-bunchgrass grasslands	M	
	Dry open forest	L	
	shrub wetlands, herb wetlands	L	Provide abundant insects for chicks, but not listed in literature as important habitats
	Water bodies, closed-canopy coniferous forest, mine, reclaimed mine, cutbank, urban, rural, road, cultivated field, rock/talus outcrop, exposed soil	N	Although CSTG may use alfalfa fields for feeding and nesting (Hoffman and Thomas 2007; Utah DWR 2002), most reclaimed alfalfa-seeded polygons in the LSA do not currently provide sufficiently dense cover. Cultivated grain fields are not present in the LSA.
Structural stage	1	N	
	2-4	H	Nesting/brood-rearing habitat
	5-7	M	

Table 5. Assumptions for Living during the Winter Season

Variable	Value	Maximum Rating	Comments
BEC zone	BG, IDF, PP	H	

Variable	Value	Maximum Rating	Comments
Ecosystem Unit	riparian aspen, riparian cottonwood, riparian water birch, riparian mixed forest, subhygric mixed forest, water birch ecosystems	H	
	shrub wetlands, sage/rabbitbrush grasslands	M	
	herb grasslands	L	used in low snow periods
	coniferous forest, herb wetlands	L	
	Water bodies, mine, reclaimed mine, cutbank, urban, rural, road, cultivated field, rock/talus outcrop, exposed soil	N	
Structural stage	1	N	
	2	L	used in low snow periods
	3-4	H	
	5-7	M	

4.3 Ratings Adjustments

Columbian Sharp-tailed Grouse appear to be somewhat tolerant of some anthropogenic disturbances, such as noise from vehicles and machinery. However, residential areas are associated with the presence of dogs and cats, which may result in nest disturbance and in mortality of eggs, chicks and adults. CSTG habitat within 2 km of urban and rural developments should be downgraded by one class for both winter and growing season suitability (D. Jury, pers. comm.). Areas within 2 km of known lek sites (Giesen and Connelly 1993) should be upgraded from M to H and from L to M.

4.4 Confounding Factors and Reliability Qualifier

Suitability of Sharp-tailed Grouse habitat is strongly influenced by the amount of cover (i.e. grassland vegetation height), a variable that is not available within the TEM database and is dependent on the level of grazing within the study area. The current high degree of mortality of ponderosa pine due to pine beetle may increase open grassland habitat for CTST within the study area in the near future.

The biology of the Columbian subspecies is not particularly well known (Hoffman and Thomas 2007), and relatively little information is available specific to British Columbia. This model has been prepared using BC (Kamloops area) information where available, supplemented with data from other areas of the subspecies' range (i.e. USA). It is unknown whether information from the US is directly applicable to the LSA. Limited verification of ratings has been done in the field. This model is assessed as having moderate reliability.

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SPECIES - HABITAT MODEL - Lewis' Woodpecker

This species account is based upon one originally prepared by A. Haney and Les Gyug for the Merritt TSA. It has been edited and updated for the Ajax Project.

Species Data

Scientific Name: *Melanerpes lewis*

Species Code: B-LEWO

Provincial Status: Red-listed (BC CDC 2014)

COSEWIC Status: Threatened (BC CDC 2014)

Identified Wildlife Status: Identified (May 2004)

Project Data

Area: Ajax TEM Mapping Area

Project Map Scale: TEM, 1:20,000

Ecoprovince: Southern Interior

Ecoregion: Thompson-Okanagan Plateau

Ecosection: Thompson Basin (THB)

Biogeoclimatic Zones: BGxh2, BGxw1, PPxh2, IDFxh2

1.0 DISTRIBUTION

Lewis' Woodpecker is found from southern interior BC and southwestern Alberta south to Arizona and New Mexico, and from coastal California east to Colorado (Godfrey 1986).

1.2 Provincial Range

Lewis' Woodpeckers are uncommon to common migrants and summer visitants to the southern interior, and very rare elsewhere in BC (Campbell et al. 1990). The Okanagan Valley is the centre of abundance, where they are common summer residents (Cannings et al. 1987). Small numbers winter in the south Okanagan.

Lewis' Woodpeckers are locally distributed across southern BC from Vancouver Island east to the Kootenays and north to the Chilcotin-Cariboo Basin (Campbell et al. 1990). They occur in lowland areas of the southern interior from the Okanagan valley, north sparingly to Williams Lake, east to Invermere, west to Lytton (Siddle and Davidson 1991). Lewis's Woodpecker breeds locally throughout lowland areas and valleys of the southern interior north to Williams Lake, Revelstoke and Invermere with the centre of breeding abundance in Okanagan valley (____ 1995). The exact breeding distribution is uncertain, but the historical breeding distribution extended west to Princeton (Siddle and Davidson 1991). Winter populations are found near Penticton, Summerland and Kelowna (Siddle and Davidson 1991).

1.3 Distribution on the RSA

Lewis' Woodpeckers are potentially present in suitable habitat throughout the RSA. One woodpecker was sighted near the existing Afton tailings pond, and another near the Ajax pit, both in June 2008. No signs of breeding were observed. A nesting pair of Lewis' Woodpeckers was reported in 2001 on the north side of Ironmask Hill (BC CDC 2008). According to Environment Canada (2014), habitat in the LSA is generally Low suitability for Lewis' Woodpeckers and approximately 75-124 pairs were thought to be present in the Thompson-Nicola region in 2006-2007.

1.4 Elevational Range

Occurs from sea level to 1150 metres, and breeds from 275 to 950 metres (Campbell et al. 1990).

2. ECOLOGY AND HABITAT REQUIREMENTS

Lewis' Woodpecker is a bird of mature, open woodlands and riparian areas, but is also found in urban/ suburban and agricultural areas. Their major requirement is open forest (Sousa 1983), as they generally will not inhabit closed or dense forest or open clearings (Siddle and Davidson 1991). They are occasionally found in solitary cottonwoods or willows (near a spring) in sagebrush flats far away from forest (Bent 1939).

Lewis' Woodpecker prefers open woodlands and lowland deciduous/riparian groves (Campbell et al. 1990; Galen 1989; Kaufman 1996; Stevens 1995; Siddle and Davidson 1991; Bent 1939). Primary habitat is mature open ponderosa pine and large-diameter cottonwoods, while secondary habitat consists of shade and fruit trees in urban areas. Steeger et al. (undated) lists Lewis' Woodpecker as occurring in open ponderosa pine forest and deciduous and riparian woodlands. Riparian cottonwoods are generally found adjacent to primary habitat (Siddle and Davidson 1991; Rodrick and Milner 1991).

Lewis' Woodpecker will also use farmland, pastureland, orchards, rural gardens, and urban areas (Campbell et al. 1990; Stevens 1995). They require an abundance of snags (Steeger et al. undated), live trees with dead or dying limbs, or trees with centre rot (Siddle and Davidson 1991). Ideal habitats have brush or grass understory to support insect prey populations (Siddle and Davidson 1991). They will use logged (Campbell et al. 1990; Kaufman 1996; Stevens 1995) and burned forest with standing snags (Bent 1939; Campbell et al. 1990; Gyug 1997; Kaufman 1996; Rodrick and Milner

1991; Stevens 1995). Burned areas may provide suitable habitat from 10 to 30 years following the disturbance (Sousa 1983).

Lewis' Woodpeckers are opportunistic foragers, targeting foods that are abundant. Flying insects, fruits, berries, nuts and corn make up the majority of the diet (____ 1995; Sousa 1983; Siddle and Davidson 1991). Mainly insects are eaten in spring and summer, but fruit, seeds and nuts are consumed in summer and fall when insects become less abundant (Galen 1989). Flycatching is the main foraging strategy, but insects are also caught on the ground or gleaned from trees and shrubs. Before migrating south, Lewis' Woodpecker feeds extensively on wild or cultivated fruits (Cannings et al. 1987).

Breeding occurs from May to early August in valley bottoms. Lewis' Woodpecker exhibits strong nest site fidelity (Siddle and Davidson 1991). Two to 8 eggs are laid, and incubated for about 15 days, and young fledge after about 23 days (Campbell et al. 1990). Only a single brood is raised annually (Cooper et al. 1998). The male broods the young during the night, while the female roosts in a separate cavity (Cooper et al. 1998).

Although Lewis' Woodpeckers will defend a foraging territory of up to 6 ha in winter, only the immediate nest site is defended during the breeding season.

3. HABITAT USE AND LIFE REQUISITES

3.1 Feeding Habitat

Lewis' Woodpeckers forage in open woodlands and riparian areas (Bock et al. 1992), where they forage primarily by flycatching (Galen 1989). Riparian groves or open woodlands are preferred, including forest edges or grasslands with only scattered trees. Urban and agricultural areas are also used, if suitable perches are present. Habitats used include grass/forb, shrub/seedling, young, mature and old forests (structural stages 2 - 3 and 5 - 7) (Thomas 1979). The species generally responds positively to grazing in riparian habitats (Bock et al. 1992).

3.2 Reproduction Habitat

Nesting requirements include open country with tall, scattered trees or snags, or stubs for flycatching. Open ponderosa pine forest and mature riparian deciduous are the primary breeding habitats (Cooper et al. 1998). Optimal breeding habitats contain a shrub understory (50% crown cover), but an understory component is not essential in riparian areas (BCMWLAP 2004). Burned or selectively logged forest, grassland with scattered trees, and agricultural or urban areas are also used. Optimal breeding habitat consists of mature (structural stages 6-7) open forest (25% canopy cover or less, with abundant large snags (30 cm dbh; Sousa 1983; Thomas 1979). The majority of nests are found in areas with at least 75% open canopy (Galen 1989). Lewis' Woodpeckers roost in cavities in mature deciduous and coniferous trees and snags, similar to those used for nesting (BCMWLAP 2004; Cooper et al. 1998). Although closed-canopy deciduous riparian forest may be used for nesting, generally nesting occurs only at the edge of such stands, adjacent to open areas (Cooper et al. 1998).

Lewis' Woodpecker nests primarily in living and dead deciduous and coniferous trees, with ponderosa pine and black cottonwood being the most frequently used nest trees (Campbell et al. 1990; Siddle and Davidson 1991). Nest tree species consist of black cottonwood (44%), ponderosa pine (31%), domestic cherry and apple (5%), urban (including telephone poles) (9%), Douglas-fir (3%), native aspen - alder - birch - ornamental willow - elm - Lombardy poplar (8%) (Cannings et al. 1987), with 90% of BC nests in or adjacent to open ponderosa pine forest (Siddle and Davidson 1991).

Although capable of excavating their own nest cavity, Lewis' Woodpeckers generally rely on previously excavated cavities, and occasionally use natural cavities (BCMWLAP 2004). Breeding density is proportional to snag density (Galen 1989). One snag/0.4 ha provides maximum breeding density in Washington and Oregon (Sousa 1983); 249 snags per 100 ha is required for maximum population and 125 per 100 ha for 50% of population potential (Thomas 1979).

Lewis' Woodpecker prefers nest trees with dbh greater than 30 cm (____ 1995) to 40 cm dbh (Steeger et al. undated), preferring large trees with broken tops (Bent 1939). Live or dead trees with heartrot (wildlife tree decay class 2-6) are suitable nesting and roosting trees (Siddle and Davidson 1991), but softer snags (wildlife tree decay class 4-6) are preferred (BCMWLAP 2004). Reported nest heights above ground ranged from 1.0 metres (fallen pine) to 18.5 metres, with a mean of 7.8 metres (Cannings et al. 1987); from 1.0 to 30.5 metres with most nests recorded between 3.5 and 9 metres (Campbell et al. 1990); and from 1.5 to 52 metres (Rodrick and Milner 1991); 80% were between 5 and 15 metres above ground (Siddle and Davidson 1991).

Lewis' Woodpeckers can habituate to some degree of routine human disturbance (Cooper et al. 1998). In ponderosa pine habitat, disturbance within 100 metres will generally result in flushing woodpeckers from the nest, however some instances of tolerance to humans in urban/suburban areas are known (Siddle and Davidson 1991; Cooper et al. 1998).

3.3 Seasons of Use

Lewis' Woodpecker winters in southern Oregon south to Mexico (Environment Canada 2014). Migrating birds arrive in BC in mid-April with most birds returning in the first 2 weeks of May.

Egg-laying begins in early May and peaks in late May and early June; hatching begins in early May and peaks between mid-June and mid-July (Cannings et al. 1987). Eggs have been recorded from mid-April to late June, and brood dates ranged from early May to early August (Campbell et al. 1990; Siddle and Davidson 1991). Most birds leave during the last week in August (Cannings et al. 1987); and early September, and by the end of September most birds have gone (Campbell et al. 1990).

3.4 Habitat Use and Ecosystem Attributes

Table 1 outlines how each life requisite relates to specific ecosystem attributes (e.g. site series/ecosystem unit, plant species, canopy closure, age structure, slope, aspect, terrain characteristics).

Table 1. Terrestrial Ecosystem Mapping (TEM) Relationships for Lewis' Woodpecker.

Life Requisite	TEM Attribute
Reproducing-Eggs	• structural stage • Ecosystem unit

4.0 RATINGS

The life requisite that will be rated for Lewis' Woodpeckers is Reproducing-Eggs, which is satisfied by the presence of suitable nesting habitat.

There is an intermediate level of knowledge on the habitat requirements of Lewis' Woodpeckers in British Columbia and thus, a 4-class rating scheme will be used(RIC 1999; Table 2).

Table 2. Description of 4-Class Rating Scheme (RIC 1999).

% of Provincial Best	Rating	Code
100% - 76%	High	H
75% - 26%	Moderate	M
25% - 1%	Low	L
0%	Nil	N

4.1 Provincial Benchmark

Ecosection: Southern Okanagan Basin (SOB); Northern Okanagan Basin (NOB); Southern Okanagan Highland (SOH).

Biogeoclimatic Zone: BG, PP

Habitats: open mature and old ponderosa pine forests with high abundance of large snags, and mature lowland cottonwood riparian.

Provincial Benchmark Density (3 pairs/100 ha) is proposed as the maximum density found in East Kootenays by Cooper and Beauchesne (2000) in Finlay Creek Burn (IDFdm), since no densities appear to be currently available for the benchmark ecosections and BEC zones listed above.

4.2 Ratings Assumptions

Assumptions are summarized in Table 3. The maximum rating on the Ajax LSA is Low (Environment Canada 2014).

Table 3. Assumptions for Reproducing-Eggs during the growing season.

Variable	Value	Maximum Rating	Comments
BEC subzone	BG, IDF, PP	L	
Ecosystem Unit	Open dry Py forest, riparian cottonwood forest	L	
	Moist coniferous forests, rock/talus outcrop, grasslands	L	large snags and scattered trees may be present
	Aspen forest, Fd forest	L	
	Urban, rural	L	
	Water bodies, mine, reclaimed mine, cutbank, road, cultivated field, exposed soil, wetlands, cultivated field	N	
Structural stage	1-3	L	large snags and scattered trees may be present
	4	N	
	5	N	
	6-7	L	

4.3 Ratings Adjustments

Riparian cottonwood habitat (Table 3) that is not adjacent to an opening (structural stage 2 or 3) should be downgraded by one class.

Table 3. Riparian cottonwood habitats that should be downgraded to Nil if not adjacent to an opening.

Subzone	Site Series
BGxw1	06, 07
PPxh2	07

Additional adjustments may be done from the VRI attributes as listed in Table 4.

Table 4. Ratings Adjustments from VRI Attributes

Attribute	Adjustment

Crown Closure = 0	Decrease to Nil
Crown Closure 1 to 10, AND Spec_cd_1 does not equal AC or PY AND Spec_cd_2 does not equal AC or PY	Decrease to Nil

4.4 Confounding Factors and Reliability Qualifier

The current mass mortality of Py due to beetle attack has resulted in an abundance of dead Py on the LSA. Once these trees fall, however, Py snags will be scarce on the study area as the majority of young to mature Py has also been killed and will not recruit into larger diameter classes. The pine beetle has been listed as a medium-concern threat to Lewis' Woodpecker, while urban and agricultural development are listed as high-concern threats (Environment Canada 2014).

Rock, talus and grasslands (structural stages 1-3) have been rated higher than nil on the assumption that scattered Py snags are often present in these habitats. However, polygons that do not have Py present will be unsuitable for nesting.

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SPECIES – HABITAT MODEL - Williamson's Sapsucker

This species account is based on one prepared by Les Gyug in 2006 for the Nicola Similkameen Innovative Forestry Society, and revised for the Ajax Project.

Species Data

Common Name: Williamson's Sapsucker

Scientific Name: Sphyrapicus thyroideus

Species Code: B-WISA

Provincial Status: Blue-listed (BC Conservation Data Centre 2014).

COSEWIC Status: Endangered (2005); SARA: Schedule 1

Identified Wildlife Status: Identified (2004).

Project Data

Area: Ajax LSA

Project Map Scale: TEM, 1:20,000

Ecoprovince: Southern Interior

Ecoregion: Thompson-Okanagan Plateau

Ecosection: Thompson Basin (THB)

Biogeoclimatic Zones: BGxh2, BGxw1, PPxh2, IDFxh2

1.0 DISTRIBUTION

Williamson's Sapsucker is found from southern interior BC south through mountainous areas to southern California, northern Baja, and northern New Mexico (Cooper 1995).

1.2 Provincial Range

Williamson's Sapsucker is classified as a breeding species and uncommon summer resident in the province (Cannings et al. 1987). It is an uncommon migrant and summer visitant to the Thompson-Okanagan Plateau and Kootenay Trench (Campbell et al. 1990). Williamson's Sapsuckers do not breed in Canada except in British Columbia, although they have been occasionally seen in Alberta and Saskatchewan. The remainder of the species' range is to the south in the United States.

The species breeds as far north as Scottie Creek (NE of Cache Creek), and west to Hat Creek (W of Cache Creek), Botanie Valley (W of Spence's Bridge) and Manning Park (Cooper 1995); there are occasional breeding records near Kamloops as far north as Skull Mt (Barriere). The Kelowna area is the extreme northern limit of their range in the Okanagan with some reported west to Mount Kobau and Terrace Mountain. The records in the Okanagan are mainly from Anarchist Mountain, east of Osoyoos (Cannings et al. 1987). The primary area of abundance (85% of provincial population) is from east of Okanagan Valley west to Greenwood (COSEWIC 2005).

Ecosections

Williamson's Sapsucker is most abundant in South Okanagan Highlands (Cannings et al. 1987), although this generalization may be more general than the current ecosection boundary. Breeding records referred to in Cooper (1995) are from SOB, SOH, NOH, (many occurrences in these 3 ecosections), STU (5 occurrences), PAR (2 occurrences), NOB (1-2 occurrences), HOR (1 occurrence), and NTU/THB (1 occurrence). The general pattern did not change with COSEWIC (2005) reassessment, nor with the 2006 surveys although it is now apparent that they are present in the GUU and the NIB in the Merritt TSA as well.

BEC Zones

Breeding records referred to in Cooper (1995) are from IDFxh1, IDFdm1, IDFdk2, IDFunk, MSdm2, ESSFmw, and at or near the IDFxh2/IDFdk1 and IDFxw/IDFdk3/MSxk. Table 1 outlines the current knowledge of BEC zone and variant use by nesting WISA. The majority (69%) is in the IDFxh, with most of these in the IDFxh1 (Princeton) with some in the IDFxh2 at Merritt and Kamloops.

Table 1. Biogeoclimatic Ecosystem Classification (BEC) units used for nesting by the *thyroideus* subspecies of Williamson's Sapsuckers in British Columbia, 1980-2005. Not all the records from Merritt TSA and others can be used since the exact locations of some of the records derived from Cooper (1995) and BC Nest Record Scheme are not known.

	Okanagan-Boundary Population (1996-2004)		Merritt TSA and other Populations (updated to 2006)	
BEC Unit[1]	N	%	N	%
PPxh2	0		1	1.8
IDFxh1	10	10.9	18	32.7
IDFxh1a	0		10	18.2
IDFxh2	0		10	18.2
IDFxh4	1	1.1	0	
IDFdk1	0		10	18.2
IDFdk2	0		4	7.3
IDFdm1	64	69.6	0	
MSdm1	15	16.3	0	
ESSFmw	0		2	3.6

	Okanagan-Boundary Population (1996-2004)		Merritt TSA and other Populations (updated to 2006)	
BEC Unit[1]	N	%	N	%
Total	92		55	

1.3 Distribution on the Study Area

Cooper (1995) does not list any breeding locations for Williamson's Sapsucker near Kamloops. Two possible WISA sightings were made during bird surveys on the Ajax study area in 2007 and 2008, respectively, but the quick glimpses of the birds did not permit confirmation of species.

1.4 Elevation Range

Williamson's Sapsucker is confined to higher elevations (Bryan and Mulholland 1992); 310 to 1425 metres (Campbell et al. 1990); middle elevations (Conway and Martin 1993). It has been recorded as breeding between 850 and 1300 metres (Campbell et al. 1990), from 1050 to 1200 metres (Cannings et al. 1987) and 850 to 1200 metres (Cooper 1995). Based on 33 nests found by Gyug and Bennett (1995), Manning and Cooper (1996) and Gyug (1999), 62% were between 1000 and 1190 metres, with the remainder as high as 1479 metres. In the Merritt TSA, most nests were found between 800 and 1200 m.

2.0 ECOLOGY AND HABITAT REQUIREMENTS

Williamson's Sapsucker is the least numerous and most ecologically and genetically specialized species in its genus (Crockett and Hadow 1975; Johnson and Zink 1983). It occupies montane forests (Campbell et al. 1990), including pure coniferous and mixed coniferous/deciduous forests, including western larch, interior Douglas-fir, and ponderosa pine. It is listed as being most abundant in mature coniferous forests dominated by western larch (Cooper 1995) and in middle elevation ponderosa pine and Douglas-fir forests (Thomas et al. 1979). Smith (1982) found Williamson's Sapsucker only on spruce plots (which included some aspen, many firs and dead trees and an even distribution of spruce of all size categories), and fir plots (which include many small aspens, large firs, small amount of spruce, many dead trees of various sizes). Williamson's Sapsucker is observed occasionally in orchards in the Okanagan valley but is not known to breed there (Bryan and Mulholland 1992).

Home ranges of Williamson's Sapsucker in western larch habitats in British Columbia (17-54 ha) appear to be larger than in ponderosa pine and trembling aspen habitats in Colorado and Arizona (4-11 ha) (see COSEWIC 2005). Methodologies of determining territory size have been quite variable, and are difficult to compare. In Lw forests, usual internest spacing in benchmark habitat is 400-450 m. This appears to be lower in At/Py habitats in the U.S. (175-375 m), that may be more similar to Ajax area habitats.

Densities reported in Canada range from 0 to 3.2 breeding pairs per 100 ha, only using census areas larger than 100 ha. Data is similar for the US but with only one density higher than this at 4.85 nests/100 ha in San Juan National Forest (Py forest with nests in At patches). In the August Lake area, 4 nests and 2 other breeding pairs, and one other territorial male were detected in 4.5 km^2. This is a density of 1.3 breeding pairs per km^2 (L. Gyug, pers. comm.).

3.0 HABITAT USE - LIFE REQUISITES

3.1 Nesting

In Colorado, Williamson's Sapsuckers favoured nest sites adjacent to open ponderosa pine forest (Crockett and Hadow 1975; Smith 1982) but actual nest stands were typically trembling aspen stands of 0.34 ha size with density of 772.4 trees/ha (range 182-1312 trees/ha; Crockett 1975). Conway and Martin (1993) found much lower aspen densities in nesting stands (mean 12.7/ha) probably because conifers made up the majority of the trees in the nesting stands. Crockett and Hadow (1975) and Smith (1982) found Williamson's Sapsuckers nesting in aspens to be foraging in nearby ponderosa pine stands, rather than in the aspen stands where they nested.

Stands used for nesting can vary from densely forested stands to very open stands with only occasional scattered trees. Detailed quantitative vegetation data for Williamson's Sapsucker nest stands in British Columbia have not been collected. Forest cover mapping at 1:20,000 developed by the BC Ministry of Forests was used to describe the nest stands of 116 nests (Gyug unpublished data) in simple terms: 56.9% of the nest stands were Closed Forest (>30% tree canopy closure), 12.9% were at the edge of Closed Forest adjacent to an opening, 6.9% in Open Forest (10-30% tree canopy closure), 19.0% in Open areas (<10% tree canopy closure) either from logging or land clearing (8.6%), from wildfire (1%), or naturally open (9.5%). However, even though Open areas were used for nesting; almost all foraging trips observed from nests in Open areas were into nearby Forest stands. No nest was further than 140 m from a forested stand. The mean distance of nests from forested stands was 73 m (n = 21, SE = 8.4 m) for those nests in Open areas.

Of 16 known nest trees in the Merritt TSA, 6 were in Open Range between 50 and 120 m from closed forests of 30 to 50% canopy closure. Therefore, the adjacent foraging stand is important in defining the habitat. The remainder of the nests were in closed forest (n=7), at the edge of open forest (n=1) and in selectively logged forest (n =2).

The highest density of nest trees (n=8) is in the August Lake area SE of Princeton in (or within 60 m of) 4 polygons. Three of these had veteran layers of Py80-90Fd10-20 of 4-5% crown closure projected age of 204-224 years. Layer 1 in these polygons were 78-107 years old, 40% crown closure, Py80Fd20, Fd80Py20 and At60Fd40. The fourth polygon was a multi-age polygon within minimum age 57, maximum age 300, Fd63Py37, crown closure 40%.

For the other 8 nests, 1 was in 188 year old Py70At20Fd10 and the other 7 were in open At or Py habitats that were at densities too low to map in FC mapping (NSR or OR) but within 100 m of closed forests with 5 of them within 100 m of dominant Py or Fd stands >188 years old. The last 2 were within 100 m of 88-year old Fd90Pl10 where veterans were present but too scarce to map.

Other descriptions of Williamson's Sapsucker nesting habitat types based on separate data sets include:

- in one study birds nested in or adjacent to open stands of ponderosa pine (Crockett and Hadow 1975)
- in western USA, both conifers and aspens have been reported as the preferred nest trees (Cooper 1995); favour conifers as nest sites however nest in aspen (Crockett and Hadow 1975);
- nest site selection in aspens and small aspen groves (0.5 ha) (Smith 1982); 85% of nests were in aspen in Colorado and Wyoming (Crockett and Hadow 1975); most common nest site was in quaking aspen within coniferous forests (Conway and Martin 1993)
- nest site areas had higher snag densities (7.7 snags/ha) and taller snags with greater dbh than surrounding forest (Conway and Martin 1993)
- prefer to nest in tall aspen snags near bottom of snow melt drainages and no nests were found on ridge tops (Conway and Martin 1993)
- breeds in patches of forest with very large ponderosa pine near Princeton (Cooper 1995)
- Habitat use is very traditional and most of the young do not disperse more than a few km (based on only one tagging study (Crockett 1975) which found 3 of 6 tagged nestlings returned to nest within 3 km of the natal nest within 2 years).

Nest Attributes

WISA are very traditional and will reuse the same tree, but usually excavate a new nest hole each year. WISA are relatively weak excavators that require trees with heart rots for nesting. Age of stand is a good stand-in for presence of older trees (Py, Fd or At) with heart rots. Up to 109 nest holes have been found in one Lw in BC (although not all those nest holes were WISA holes). Some of those trees were used for 3 successive years for nesting (and probably longer as well) with a new hole excavated each year, although in At often the same hole was reused (Gyug unpublished data).

Nest trees: At-8 (3 dead and 5 live), Fd-3 (2 live and 1 dead), Py-7 (5 dead and 2 live) (counting nest trees only once even if used more than once). Nest tree DBH (counting each nest tree only once, even if used for more than one year): At 23, 27, 32,33,34 (Mean 29.8); Fd 35, 114, 120; Py 39, 42, 50 71, 83, 84 (Mean 61.5).

Other descriptions of Williamson's Sapsucker nests based on separate data sets in similar habitat (Py/At) to Merritt TSA include:

- average nest height of 2.4 metres in aspen and 5.1 metres in pine (Crockett and Hadow 1975); nest height averaged 13.1 metres which correlated with tree height (Conway and Martin 1993)
- aspen used near Merritt and Cache Creek (Cooper 1995);
- in Arizona, most nests found in aspen snags, some in live aspen and one in unidentified snag; no nests were found in conifer snags; dbh of live aspens for nesting 36.2 cm and for snags 38.1 cm (Conway and Martin 1993)

- in Colorado, average nest tree dbh is 23.5 cm for aspen and 50.9 cm for pine (Crockett and Hadow 1975).

3.2 Feeding Habitat

Diet (as summarized by Dobbs et al. 1997) consists of conifer sap and phloem during prenestling period, shifting to mainly ants (carpenter ants in particular) gleaned from tree trunks after hatching of young. Conifers used for sapwells are small to medium (20-50 cm dbh) Fd or Py (or others where there may be others). Pairs maintain 4-5 sap trees within 250 m of the nest (but most often <100 m) that they visit several times daily throughout the breeding season to keep sap wells open.

Both young and mature trees with flowing sap are required as well as older and larger dead trees that will be inhabited by ants (particularly carpenter ants) for feeding nestlings, and for adult food in the late spring and summer. Age of stand (>180 years) is a good stand-in for presence of large snags and standing trees with heart rots that are infected with carpenter ants.

Other descriptions of foraging habitat are:

- forages in both forest and 25-year old "clearcut with residuals" in Wallace Creek based on radio-telemetry data (Manning and Cooper 1996)
- mainly in Douglas-fir and western larch (Cooper 1995);
- forage in conifers and dead trees (Smith 1982)
- fed on dry hillside dominated by ponderosa pine (Crockett and Hadow 1975)
- did not forage in burned areas (Smith 1982).

3.3 Seasons of Use

Williamson's Sapsuckers arrive mid-April and most leave by mid-September, but they are occasionally found up to mid-October (Campbell et al. 1990). Cannings et al. (1987) states that they arrive late March and early April and leave by mid-September, and cite a couple of records after this date.

Foraging habitat is used from April to September. Eggs have been found from late April to mid-June (Bryan and Mulholland 1992). Incubation begins in May and young fledge in second half of June and early July (Cannings et al. 1987). Egg laying occurs in BC between late April and late May (Cooper 1995); broods range from early May to mid-July (Campbell et al. 1990).

4.0 RATINGS

This model employs a 6 class rating scheme (Table 2), complying with the recommended rating scheme in RIC (1999). Sufficient density and habitat information has become available since 2003 to apply the 6-class scheme to Williamson's Sapsucker.

Table 2. Six-class ratings scheme (From RIC 1999).

% of Provincial Best	Rating	6 Class Rating
100% - 76%	High	1
51% - 75%	Moderately High	2
50% - 26%	Moderate	3
25% - 6%	Low	4
5% - 1%	Very Low	5
0%	Nil	6

The Williamson's Sapsucker model profiles Reproducing-Eggs (RE) and foraging (FD) habitats. These life requisites occur in similar habitats at the 1:20,000 scale, and are therefore modeled as the living (LI) life requisite. Breeding (nesting) occurs during the spring and foraging can extend from April to September, therefore living is modeled for the growing season.

4.1 Provincial Benchmark

Provincial benchmark density is at Schoonover Mountain, east of Okanagan Falls, at the junction of 201, 200, Dutton and Browning FSR on TFL 15 (see COSEWIC 2005).

Provincial Benchmark at 1:20,000 scale

Density of 3.2 active nests/breeding pairs per km^2.

Ecosection: South Okanagan Highlands/North Okanagan Highlands (SOH/NOH)

Biogeoclimatic Zone: IDFxh1/IDFdm1

Habitat: Predominant forest (>75%) in area containing large (>65 cm dbh) western larch at densities >>1/ha.

4.2 Ratings Assumptions

1. The maximum habitat rating in the Ajax TEM-mapped area is Low or 4 in old-growth (>200 year) Py forests in the IDFxh (L. Gyug, pers. comm. 2012). WISA is near the north end of its

distribution in the study area (COSEWIC 2005), and is nowhere common, even in what would appear to be suitable habitat.

2. Williamson's Sapsuckers use pure coniferous and mixed coniferous/deciduous forests, with a preference for western larch and ponderosa pine. They are most abundant in mature coniferous forests dominated by western larch (which does not occur in the study area). Best habitat overall will include nest sites, young and mature trees for feeding on sap, and veteran or dead trees for catching ants to feed to nestlings. Breeding habitat is only useful when adjacent to foraging habitat so that both must occur in the same spot or beside each other. Therefore only one habitat value layer, living, is modeled.
3. Since habitat requirements are more restrictive for nesting sites than for foraging, the model will be based on nesting requirements but only when in association with foraging sites.
4. Ecosystems that are drier than mesic will be rated lower than mesic and wetter ecosystems because these are poorer growing sites for the sizes of trees required for nesting.
5. There is no known correlation with slope or aspect for Williamson's Sapsucker, although mesic and wetter sites will tend to be on less steep slopes.

Assumptions are summarized in Table 3.

Table 3. Assumptions for rating Living habitat for Williamson's Sapsucker.

Attribute	Value	Maximum Rating
Subzone	IDFxh	4
	BG, PP	6
Ecosystem Unit	Mesic Py forest	4
	At forest, dry Py forest, Fd forest	5
Structural Stage	6-7	4
	5	5
	1-4	6

4.3 Ratings Adjustments

No adjustments are specified.

4.4 Reliability Qualifier

The ratings are considered to be of Moderate reliability. Some field verification has been undertaken in the Merritt Forest District and Ajax LSA.

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SPECIES - HABITAT MODEL - Flammulated Owl

Original model prepared by Chris Albrecht, Keystone Wildlife Research Ltd. Original species account adapted from Sinclair *et al.* (1999) and van Woudenberg (2000).

Species data

Scientific Name: *Otus flammeolus*

Species Code: B-FLOW

Provincial Status: Blue-listed

COSEWIC-status: Special Concern (Nov 2001)

SARA-status: Schedule 1 (Special Concern)

Identified Wildlife: Yes (May 2004)

Project data

Area: Ajax LSA

Project Map Scale: TEM, 1:20,000

Ecoprovince: Southern Interior

Ecoregion: Thompson-Okanagan Plateau

Ecosection: Thompson Basin (THB)

Biogeoclimatic Zones: BGxh2, BGxw1, PPxh2, IDFxh2

Project Map Scale: 1 : 20,000

1.0 ECOLOGY AND HABITAT REQUIREMENTS

The Flammulated Owl is a small, grey-brown owl that inhabits coniferous forests. It is a secondary cavity nester that primarily associates with older forests dominated by Douglas-fir and containing significant components of ponderosa pine (Campbell *et al.* 1990). Nests are generally placed in large-diameter (>75 cm) ponderosa pine snags or live trees, often in Pileated Woodpecker or Northern Flicker cavities. Nesting individuals rarely re-use the same nest cavity in different years, but have a high fidelity for nesting sites, often returning to the same area to breed in subsequent years. Territories can be up to 20 ha in size, and are typically located on upper slopes with warm aspects and crest positions along the ridgelines above the large river valleys. In B.C., they prefer to nest on westerly aspects (Christie and van Woudenberg 1997).

The Flammulated Owl is insectivorous and hunts within forest openings in the A2, A3 and B1 canopy layers (van Woudenberg 1992). It takes Orthopterans and Lepidopterans on the wing (Goggans 1986; Reynolds and Linkhart 1987) and gleans western spruce budworm (*Choristoneura occidentalis*) from thicket canopies (A3 canopy layers) during outbreaks (van Woudenberg 1992).

2.0 DISTRIBUTION

2.1 Provincial Range

The Flammulated Owl is only found in British Columbia during the breeding season, and the province represents the northern edge of the species' range. Within B.C., the owl is restricted to mountains and valley-sides, breeding mostly in the south-central interior as far north as McLeese Lake (Campbell *et al.* 1990; Fraser *et al.* 1999). It is classified as an uncommon neo-tropical migrant to B.C., breeding mostly in the Okanagan valley and Thompson Basin (Campbell *et al.* 1990).

2.2 Distribution on the Project Area

Flammulated Owls have not been confirmed present within the LSA. If present, they would be expected to occupy areas of older coniferous forest.

2.2.1 Elevation Range

The Flammulated Owl is found between 375 m and 1375 m elevation in B.C., with nests in the Merritt area recorded between 400 m and 1375 m elevation (Campbell *et al.* 1990; van Woudenberg *et al.* 1995).

3.0 FOOD/COVER LIFE REQUISITES AND HABITAT-USES

Flammulated Owls are migratory birds that only occur in the province during the breeding season. Available information on Flammulated Owls indicates that at the scale of mapping for this project, living and reproducing life requisites will correlate closely, therefore ratings will be prepared for living during the growing season (Table 1).

Table 2. Life requisites rated for Flammulated Owl.

Life requisite	Habitat-use	Months	Rating column title
Feeding, Security, Reproducing-eggs	Living during the growing season	May-Oct	BFLOW_G

Living-Growing

Living during the growing season requires suitable amounts of foraging and security habitat, as defined below.

Feeding Habitat

This species forages in mature or old-growth, conifer-dominated forests (Fenger et al. 2006). It prefers Douglas-fir thickets adjacent to small openings (<0.5 ha), with optimal foraging habitat existing in the IDFxh because openings persist in this variant, unlike in moister variants where openings are lost to forest encroachment in later seral stages (Lloyd et al. 1990; van Woudenberg 1992). The Flammulated Owl is strictly insectivorous, feeding primarily on moths and caterpillars within the tree canopy as well as grasshoppers, crickets and beetles taken from the ground, grass and shrub layers. Furniss and Carolin (1980) found that Douglas-fir/ponderosa pine forests have the highest variety of Lepidopterans, which may partially explain the owls' preference for foraging in these forests.

Security Habitat

Security habitat consists of A3 and B1 forest canopy layers within small Douglas-fir thickets (<0.5 ha) (van Woudenberg 1992). Thickets of Douglas-fir regeneration often occur as a successional feature (D. Low pers. comm.; as cited in van Woudenberg 2000) but in wetter BEC variants (e.g. IDFxm, mw) regeneration occurs quicker in moister growing sites with higher productivity (Lloyd et al. 1990). Therefore this feature is present for shorter periods of time in wetter sites relative to drier (e.g. IDFxh) sites (D. Low pers. comm.; as cited in van Woudenberg 2000). Within the IDFxh2, van Woudenberg (1992) found lower stem density, more open thickets and more-developed canopies in xeric habitat types (site series 2-3), while mesic habitat types (site series 4-6) had higher stem density (less-preferred), and were home to a higher density of Barred Owls (*Strix varia*), the primary predator of the Flammulated Owl.

Roosting trees generally consist of large-diameter, heavily-branched trees which provide security cover, and are often either Douglas-fir or ponderosa pine (Reynolds and Linkhart 1987; McCallum 1994). Dwarf mistletoe is also suspected to enhance the suitability of a tree for roosting (McCallum 1994).

Flammulated Owl nesting habitat consists of mature forest, with well-spaced trees of varying ages, some dense patches of regenerating trees (80-120 years old; for escape cover) and a significant proportion of veteran Douglas-fir and ponderosa pine. The understory is very open and consists mainly of pinegrass, bluebunch wheatgrass, birch-leaved spirea and isolated taller shrubs such as saskatoon (Campbell et al. 1990). Trembling aspen copses located within conifer-dominated forests are also used for nesting (Fenger et al. 2006). Nest sites are located in large-diameter Douglas-fir and ponderosa pine snags (>30 cm dbh; Fenger et al. 2006). Most nests in natural sites have been found in abandoned woodpecker nest cavities (Campbell et al. 1990).

Seasons of Use

Flammulated Owl migrants start to arrive in B.C. in early to mid-May, and begin breeding in May (Cannings et al. 1978; van Woudenberg 1992; Campbell et al. 1990). Fledging is completed in late August (Christie 1994; van Woudenberg 1992), but migrants may remain in the province until mid-October, although the fall migration timing in B.C. has not been confirmed (Linkhart and Reynolds 1987). Table 2 provides monthly life requisites for Flammulated Owl.

Table 2. Monthly Life Requisites for Flammulated Owl

Month	Season*	Life Requisites
January-March	Winter	N/A
April	Growing (Early Spring)	N/A
May	Growing (Late Spring)	Living
June	Growing (Summer)	Living
July	Growing (Summer)	Living
August	Growing (Summer)	Living
September	Growing (Fall)	Living
October	Growing (Fall)	Living
November-December	Winter	N/A

*Seasons defined for the Southern Interior Ecoprovinces as per British Columbia Wildlife Habitat Rating Standards Version 2.0 (1999).

Habitat Use and Ecosystem Attributes

Table 3 outlines how each life requisite relates to specific ecosystem attributes (e.g., site series/ecosystem unit, plant species, canopy closure, age structure, slope, aspect, terrain characteristics).

Table 3. Mapping relationships for life requisites for the Flammulated Owl.

Life Requisite	Mapping Attributes
Living	Subzone variant Site: Site series, structural stage, aspect

4.0 RATINGS

There is an intermediate level of knowledge on the habitat requirements of the Flammulated Owl in British Columbia and thus, a 4-class rating scheme will be used (Table 4).

Table 4. Description of 4-Class Rating Scheme (RIC 1999).

% of Provincial Best	Rating	Code
100% - 76%	High	H
75% - 26%	Moderate	M
25% - 1%	Low	L
0%	Nil	N

4.1 Provincial Benchmark

No provincial benchmark has been designated for the Flammulated Owl. Benchmark habitat likely consists of open-canopy, mature Douglas-fir or ponderosa pine forests within the IDFxh zone (see Lloyd *et al.* 1990; van Woudenberg 1992).

4.2 Assumptions

Assumptions are summarized in Table 6.

Table 6. Assumptions for habitat use by Flammulated Owl

Attribute	Assumptions for Living in the Growing season
BEC Variant	• The IDFxh and PPxh variants will be rated up to H. • The BG variants will be rated up to L.
Site Series	• Dry forests will be rated up to H. • Mesic and subhygric forests will be rated up to M. • Grasslands will be rated up to L. • All other units will be rated N.
Structural Stage	• Structural stages 6-7 will be rated up to H. • Structural stages 2-3 and 5 will be rated up to L. • Structural stages 0, 1 and 4 will be rated N.
Aspect	• Warm (w, z) aspects will be rated up to H. • Cool (k, q) and nil aspects will be rated up to M.

4.3 Reliability Qualifier

Moderate reliability – The model is based on a mixture of information, partly obtained from local studies and reports regarding Flammulated Owl biology in British Columbia in particular.

5.0 MAP THEMES AND RATING ADJUSTMENTS

5.2 Adjustments

Flammulated Owls live in mature or old-growth forests (Fenger *et al.* 2006), but use small grassland openings in these forests for foraging (van Woudenberg 1992). However, they prefer small forest openings (<0.5 ha; *ibid*.), and thus any grassland polygon that is larger than 0.5 ha will be downgraded to nil for living during the growing season.

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SPECIES – HABITAT MODEL - Western Rattlesnake

This species model was originally prepared by Crystal Swayze and Mike Sarell for the Nicola-Similkameen Innovative Forest Practices Society. It has been updated and revised for the Ajax Project.

Species data

Common Name: Western Rattlesnake

Scientific Name: *Crotalus oreganus,* western rattlesnake; *Crotalus oreganus oreganus*, Northern Pacific rattlesnake (Crother 2000; BC Conservation Data Centre 2014). Formerly known as *Crotalus viridis oreganus*.

Species Code: R-CROR

BC Status: Blue-listed (BC CDC 2012a)

COSEWIC Status: Threatened (May 2004); SARA: Schedule 1 (BC CDC 2014)

Project Area and Map Scale

Area: Ajax TEM Mapping Area

Project Map Scale: TEM, 1:20,000

Ecoprovince: Southern Interior

Ecoregion: Thompson-Okanagan Plateau

Ecosection: Thompson Basin (THB)

Biogeoclimatic Zones: BGxh2, BGxw1, PPxh2, IDFxh2

1.0 DISTRIBUTION

Occurs in south central British Columbia south to Baja California and east to Idaho, eastern Utah and Arizona. The northern Pacific rattlesnake subspecies, *Crotalus oreganus oreganus,* occurs in British Columbia, eastern Washington and the northern half of California.(Stebbins 1985; Ashton and de Queiroz 2001 in COSEWIC 2004).

1.1 Provincial Range

The rattlesnake is restricted to the very dry BC interior. The species' range occurs in four separate regions, including the Okanagan-Similkameen population, east along the Canada / USA border to Christina Lake (Kettle River population) north to Kamloops and Cache Creek (Thompson/Nicola population) and west to Lillooet (Fraser population) (COSEWIC 2004). The adult snake population is small, likely fewer than 5000, and spread among only five valleys, probably with little interchange of individuals between valleys. Threats to the species are increased in effect because this snake matures late (~8 years), has small litters and only breeds every 3-4 years (Didiuk et al. 2004).

1.2 Elevational Range

Elevation range appears to be below 800 m (BC Ministry of Water, Land and Air Protection 2004). Most of the dens found in Thompson and Okanagan were found on warm aspects at elevations of 300 to 1000 m above sea level (Sarell 1993; Hobbs 2001).

1.3 Distribution on the Study Area

Rattlesnakes were not detected within the Ajax LSA during field surveys, and local residents do not report historical rattlesnake sightings. No rattlesnake hibernacula have been documented within or near the study area (Hobbs 2013), although the habitat within the study area appears suitable.

2.0 ECOLOGY AND HABITAT REQUIREMENTS

'Adult western rattlesnake lengths are from 60 to 150 cm. Its broad triangular-shaped head which is much wider then the neck, can readily distinguish the rattlesnake. The background color is brown, tan, olive grey, overlaid by large dark-brown blotches along the back and smaller blotches along the sides. Towards the tail, the blotches appear more like bands around the body and the tail ends with a rattle. The underside is normally yellowish and sometimes can be brownish. Males and females have similar appearances' (Blood 1993).

Foraging mainly occurs from dawn to dusk, when the snake's important prey animals are active (Blood 1993). In British Columbia, the feeding rate was found to be low from March through May (22/2057 snakes with food), increased and remained consistent at 17% through June, July and August (111/656 with food) and dropped to 7.9% in September (75/945 with food). Very little feeding occurred in October when the snakes were at the hibernaculum (Macartney 1989, as cited in COSEWIC 2004).

The size of prey items ingested by the rattlesnake is positively related to snake size (Macartney 1985, cited in COSEWIC 2004). The diet of juveniles was almost exclusively small mammals, especially shrews, deermice and voles. Other food items included pocket gophers, chipmunks and birds. The diet of adult *Crotalus oreganus* was more diverse than those of juveniles. Deermice and voles accounted for 60.5% and the larger items, pocket gophers and wood rats (*Neotoma*), accounted for 25.8%. Adults also consumed shrews, pocket mice, marmots and squirrels (COSEWIC 2004). Birds and other snakes are occasionally taken as well (Sarell pers. comm.).

Females usually emerge from the dens in mid to late April, depending on weather. Males and non-gravid females disperse to summer range, while gravid females remain near the den (Didiuk et al. 2004). Mating occurs in August or early September in British Columbia, prior to snakes returning to den sites. Mated females enter their winter den but ovulation and fertilization does not occur until they emerge the next spring (Blood 1993). Young are born August-October. Females are only capable of breeding every two to three years at the northern limits of their range (Diller and Wallace 1984), including BC (Macartney and Gregory 1988).

Rattlesnakes are at the hibernacula by October. They stay at the surface or retreat into the den and emerge for several hours on warm days until mid-October or in isolated cases until November. In British Columbia, emergence begins as early as March and peaks in April and early May. Adult females emerge first, followed in no particular order by other age classes and genders (Macartney 1985, cited in COSEWIC 2004).

Shedding in neonates occurs up to two weeks after birthing before the young snakes enter hibernacula (Charland et al. 1993). Afterwards, shedding is influenced by growth, however there does seem to be some coordination of ecdysis (M. Sarell, pers. comm. 2012).

3.0 ECOLOGY AND HABITAT REQUIREMENTS

The western rattlesnake is locally distributed within the hot and dry bunchgrass, ponderosa pine and Douglas-fir biogeoclimatic subzones (Stevens 1995). Most of the year rattlesnakes occur on warm rugged slopes, except during full summer when many retreat to cool aspect slopes or riparian areas to escape the heat (BC Ministry of Water, Land and Air Protection 2004). Vegetated gullies may be used as movement corridors and refuges during the heat of summer (BC CDC 2012).

Hibernacula are found on southeast through southwest-facing slopes, typically where deep fissures in exposed bedrock or colluvium provide retreats below the frost line (Sarell 1993). Dens have occasionally also been found on cool aspects and some snakes have used Bank Swallow burrows and earthen den features.

There is considerable site fidelity shown by this species, with individuals returning to the same den site year after year (Macartney 1985). Denning sites are most common in the Ponderosa Pine or Bunchgrass biogeoclimatic zones but some have been found in the very hot and dry Interior Douglas Fir biogeoclimatic zone ((BC CDC 2012; Hobbs and Sarell 2000; Bertram and Larsen 2001). Dens are generally located at elevations of between 300 m and 1000 m (Campbell et al. 1990; Charland et al. 1993).

Breeding and Nest Sites: Females mate in late summer while still on the summer foraging territories. Fertilization is delayed until early the following spring; females will remain near the den and do not feed during pregnancy (Macartney and Gregory 1988). Rookeries are generally within 400 m of the hibernaculum (Reptiles of BC 2004). Immediately after birth, the emaciated females enter hibernation; while the newborns stay near the den for two weeks, shed their skin, then enter the den to hibernate. Reproduction takes place every 3 years on average, since females need to double their body weight before breeding again. Reproduction often begins when female rattlesnakes are 7-9 years old (Macartney and Gregory 1988).

Foraging: Foraging tends to occur in open grasslands, parkland forest, wetlands, and riparian areas. Foraging habitats must provide suitable cover, in the form of vegetation and coarse woody debris, for protection from predators and concealment (BC Ministry of Water, Land and Air Protection 2004).

4.0 HABITAT USE: LIFE REQUISITES

Monthly life requisites for the western rattlesnake are summarized in Table 1.

Table 1. Monthly Life Requisites for the Western Rattlesnake.

Month	Southern Interior Seasons	Life Requisite
January	Winter	Hibernating
February	Winter	Hibernating
March	Winter	Hibernating/Foraging
April	Early Spring	Hibernating/ /Foraging
May	Late Spring	Foraging/Reproducing-Birthing
June	Summer	Foraging/ Reproducing- Birthing
July	Summer	Foraging/ Reproducing- Birthing
August	Summer	Reproducing- Birthing Foraging
September	Fall	Reproducing- Birthing / /Foraging/Hibernating
October	Fall	Hibernating
November	Winter	Hibernating
December	Winter	Hibernating

5.0 HABITAT USE AND ECOSYSTEM ATTRIBUTES

Table 2 outlines how growing habitat relates to specific ecosystem attributes.

Table 2. Relationship between Terrestrial Ecosystem Mapping (TEM) attributes and life requisites for the western rattlesnake.

Life Requisite	TEM attribute
Hibernating (includes ovulating, gestating, birthing)	Structural stages 1- 7 (no structural stage preferences known for this species). Forest cover includes rock outcrops, talus slopes BEC zone, site series, structural stage, slope position, aspect, soil, terrain
Living, growing	Structural stage 1- 7 (no structural stage preferences known for this species).

Life Requisite	TEM attribute
	BEC zone, site series, structural stage, slope position, aspect, soil, terrain

6.0 RATINGS SCHEME

A 4-class ratings system will be used (Table 3).

Table 3. Habitat Capability and Suitability 4-Class Rating Scheme (from RIC 1998).

% Of Provincial best	Rating	Code
100% - 76%	High	H
75% - 26%	Moderate	M
25% - 1%	Low	L
0%	Nil	N

Ratings will be provided for Hibernating, which will include habitats used for hibernation and birthing (which occurs at the opening of the den), and for Living (summer) habitat values, which will include habitats used for foraging, cover, and thermoregulation in summer.

The broadest range of habitat for the western rattlesnake is Living habitat. This habitat is usually associated with bunchgrass, ponderosa pine forest parklands, and lower portions of the IDF. Talus slopes and rock outcrops within these xeric ecosystems are used for hibernating.

Denning sites (hibernacula) are commonly found near the base of rock outcroppings within large areas of coarse talus, usually in very deep fissures, earth-covered rock outcrops or very coarse colluvium material. This habitat is critical for maintaining populations. Most snakes are found within 1 to 2 kilometres of their dens, indicating that the distribution of suitable hibernacula probably influences the distribution and viability of local populations (BC Ministry of Water, Land and Air Protection 2004). A summary of life requisites in relation to season is presented in Table 4.

Table 4. Life Requisites for Western Rattlesnake.

Life requisite	Definition	Season/months
Living (LI)	Foraging, cover and thermoregulation for all ages	Spring to Fall (Mid-March/April to late September)
Hibernating (HI)	Mating, gestation, giving birth	Spring to Fall (May to mid-September)
	Denning for all ages	Fall, Winter, Early Spring (late September to mid-April)

7.0 PROVINCIAL BENCHMARK

- No benchmark has been identified but may be the BGxh1/PPxh1 in the SOB ecosection.

As there are no records of rattlesnakes in the Ajax LSA, and local residents do not report sightings of rattlesnakes, the maximum rating assigned will be Moderate.

8.0 RATINGS ASSUMPTIONS

1. A Moderate rating for living is given to all grassland and dry to mesic open-canopy forested habitats.
2. All rock outcrops and talus slopes will be rated moderate for living.
3. Moist open-canopy forests and cultivated fields will be rated low for living.
4. Shrub wetland will be rated moderate and herb wetland will be rated low for living.
5. Riparian ecosystems will be rated moderate for living.
6. Dry to mesic closed canopy forests will be rated nil for living.
7. Exposed soil, gravel pit, water bodies, mine, road, urban, cutbank and rural will be rated Nil for living.
8. Warm aspect talus slopes and rock outcrops will be rated up to Moderate for hibernation. Cutbanks will be rated Low. All other ecosystems will be rated nil for hibernation.

Assumptions for terrain are summarized in Table 5.

Table 5. Terrain Rating Assumptions for Hibernation.

Surficial material		Rating
A	Anthropogenic	N
C	Colluvium	up to M
D	Weathered Bedrock	up to M
E	Eolian	up to L
F	Fluvial	N
FG	Glaciofluvial	N
G	Glacial	N
L	Lacustrine	N
LG	Glaciolacustrine	N
M	Morainal	N
N	None (Lakes, Rivers)	N
O	Organic	N
R	Bedrock	up to M
U	Undifferentiated	N
	Aspect Classes	Rating
	Cool, gentle	up to L
	Warm (240-285)	up to M

9.0 MAP THEMES AND RATINGS ADJUSTMENTS

Living will be modelled using the ecosystem ratings while hibernating will be modelled using terrain attributes.

Living habitats must be within 2 km of Moderate or High HI ratings from the terrain, or they should be downgraded to Nil. Living will form the backdrop of the map and security/thermal from the terrain model will form the overlay, thereby stressing the hibernating and spring/fall habitat use of the rattlesnake.

Slopes <10% should be downgraded to a maximum of Low for HI.

10.0 MODEL RELIABILITY

Moderate Reliability. Available species-habitat relationship information is based mainly on detailed studies, reports and expertise gained within British Columbia and pertaining directly to the ecosystems in the study area. Ratings have been verified within the Merritt Forest District, and within the Ajax LSA.

Validation of Security/Thermal model

The following results were derived from generating mapped terrain data from 14 known rattlesnake hibernacula in the Merritt TSA (Iredale 2006).

Code	**Subzone Variant**	**Freq**	**Percent**
PPxh2	Ponderosa Pine xeric hot Thompson	9	64
IDFxh1	Interior Douglas-fir xeric hot Okanagan	3	21
BGxh2	Bunchgrass xeric hot Thompson	1	7
IDFxh2	Interior Douglas-fir xeric hot Thompson	1	7
Code	**Terrain (Surfm 1&2)**	**Freq**	**Percent**
C	Colluvium	15	60
R	Rock	7	28
E	Eolian	1	4
M	Morainal	2	8
Code	**Slope/Aspect (Surf_e1a)**	**Freq**	**Percent**
v	steep, hot	10	71
k	steep, cool	3	21
w	moderate, warm	1	7
Code	**Slope (Slpc 1&2)**	**Freq**	**Percent**
blank	blank	9	32
0	level	2	7
1	gentle	0	0
2		3	11
3	moderately steep	2	7
4	steep	7	25
5	very steep	5	18

Code	Subzone Variant	Freq	Percent
Code	Aspect (As_cls 1&2)	Freq	Percent
h	hot	8	57
blank	blank	5	36
w	warm	1	7
Code	Aspect (As)	Freq	Percent
blank	blank	5	36
h	hot	5	36
w	warm	2	14
c	cool	2	14

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SPECIES – HABITAT MODEL - North American Racer

This species account is based on an account prepared by Ted Tom and Mike Sarell for the Nicola-Similkameen Innovative Forest Practices Society. It has been updated and revised for the Ajax Project.

Species data

Common Name: North American Racer

Scientific Name: *Coluber constrictor; Coluber constrictor mormon* (western yellow-belly racer) is the subspecies found in British Columbia (BC Conservation Data Centre 2012). Formerly known as *Coluber mormon constrictor* (Crother 2000).

Species Code: R-COCO

Provincial Status: Blue-listed (BC Conservation Data Centre 2014)

COSEWIC Status**:** Special Concern

Identified Wildlife Status: Identified (June 2006)

Project data

Area: Ajax TEM Mapping Area

Project Map Scale: TEM, 1:20,000

Ecoprovince: Southern Interior

Ecoregion: Thompson-Okanagan Plateau

Ecosection: Thompson Basin (THB)

Biogeoclimatic Zones: BGxh2, BGxw1, PPxh2, IDFxh2

1.0 DISTRIBUTION

Coluber constrictor occurs in the western portion of North America, from southern California to British Columbia in the north and east to New Mexico and Montana.

1.2 Provincial Range

In British Columbia, restricted to the dry interior bounded by the Okanagan, Similkameen, Fraser and Thompson valleys (Sarell 2004). Populations are known from the south Columbia, Kettle, Okanagan, Similkameen, Nicola, Thompson, and Fraser watersheds (Sarell et al. 1997, cited in Sarell 2004).

1.3 Distribution on the LSA

No records of racers within the LSA could be located, although the habitat is apparently suitable and the study area lies within the range of the species. The racer is potentially present in suitable habitat throughout the Ajax LSA.

1.3 Elevation Range

The racer is generally found from low to mid-level elevations below 900 m (Sarell 2004).

2.0 ECOLOGY AND HABITAT REQUIREMENTS

Adult racers are a uniform olive to bluish grey dorsal, with a yellowish venter that often becomes whiter toward the throat and head (Brown et al. 1995 as cited in Sarell 2004). Young racers resemble gophersnakes, as there is a sequence of saddle-shaped markings along the back (Matsuda et al. 2006). This pattern gradually fades from the tail to the head during the first year. Racers seldom reach lengths > 1 m (Matsuda et al. 2006).

The racer is most common in British Columbia in non-forested ecosystems but occasionally occurs in forested areas with an open canopy (Sarell et al. 1997; Sarell and Alcock 2000; Sarell 2004). Other habitats used by racers include sandy desert areas, grasslands, farmland, and marshes, usually rocky and rugged landscapes with sparse or scattered tree cover (Sarell 2004). The racer has been found in four biogeoclimatic zones in British Columbia, the Bunchgrass (BG) (Orchard 1984; Cannings et al. 1999as cited in COSEWIC 2004), Interior Douglas-fir (IDF) (Cannings et al. as cited in COSEWIC 2004), Ponderosa Pine (PP) (Orchard 1984 as cited in COSEWIC 2004) and Interior Cedar-Hemlock (ICH) (Dulisse 1999). However, they most frequently occur in the Ponderosa Pine and Bunchgrass biogeoclimatic zones (Orchard 1984 as cited in COSEWIC 2004).

Racers emerge from the dens during March or April, disperse and then mate in May on their summer ranges (Nussbaum et al. 1983; Shewchuck and Waye 1995; Cannings et al. 1999). Egg production is quick and eggs are laid in June or July.

Nest sites tend to be on south-facing slopes, in underground chambers (Sarell 2004). Females may be able to reproduce in consecutive years only if they have sufficient fat reserves. Three to seven eggs are laid in communal nests in BC (Sarell 2004). Up to 15 eggs per clutch were observed in Michigan, with clutch size correlated to size of the female (Rosen 1991). Eggs hatch in late August or early September (Nussbaum et al. 1983; Sarell 2003 as cited in COSEWIC 2004). Moisture plays a role in that hatchling size seems to be linked with high moisture content within the nest (Waye and Shewchuk 2002, as cited in COSEWIC 2004).

Racer migrations begin in late August or early September. They are usually at den sites by September but migration sometimes continues into October (temperature dependent) (Schleppe pers. comm. 2006). Solitary individuals may use dens but occasionally racers share the den with other individuals and often den communally with other species of snakes such as gophersnakes and western rattlesnakes (Brown and Parker 1976; COSEWIC 2004; Charland 1989; Radke 1989; Sarell 1993 as cited in Sarell 2004).

There is considerable site fidelity shown by this species, with individuals returning to the same den site year after year (Cannings et al.1999). Racers hibernate throughout winter from November to March and emerge in late March or April (Sarell 2003 as cited in COSEWIC 2004). Racers generally return to their den site in September but will occasionally remain active into October or even as late as November (Hobbs and Sarell 2002 as cited in COSEWIC 2004; Shewchuk and Waye 1995 as cited in COSEWIC 2004). Snakes appear to return to the dens in response to the onset of colder nights when the temperature drops below 9 degrees Celsius (Hobbs and Sarell 2002 as cited in COSEWIC 2004). Ninety-three percent of racers tracked in Utah returned to the same den site (Brown and Parker 1976). Den site fidelity may be a function of spatial home range, as snakes translocated into areas near alternate hibernacula did not return to their home den but used the alternate sites instead.

Foraging is primarily done during daylight hours, and racers actively search for prey rather than waiting in ambush. Racers are generalists, preying on insects, small mammals, lizards, and snakes (Brown et al. 1995 cited in Sarell 2004; Sarell 2004; Shewchuk and Austin 2001). Juveniles feed on crickets and grasshoppers (Brown et al. 1995 cited in Sarell 2004). Racers forage differently from other British Columbia snake species, as they seem to demonstrate a greater dependency on vision when foraging and navigating (Brown et al. 1995 cited in Sarell 2004).

Foraging tends to occur in open grasslands and shrub-steppe (Matsuda et al. 2006). However, sandy terraces along riparian margins are also frequented, presumably because of the food supply in riparian areas and the sunny, warm conditions provided by the terraces (Province of British Columbia 2001). Although racers forage in grasslands, those with some shrub cover, or with vegetation >10 cm in height, may provide more security cover from aerial predators such as raptors (Sarell 2004; M. Sarell, pers. comm.).

This snake is susceptible to habitat loss and fragmentation from agriculture and urban development, especially as this species is particularly intolerant of urbanization. The ongoing expansion of the road networks and traffic volumes increases the risk of mortality.

3.0 HABITAT USE - LIFE REQUISITES

Life requisites for the racer are summarized in Table 1.

Table 1. Life requisites for the racer.

Life requisite	Definition	Season/months
Living (LI)	Foraging, cover and thermoregulation for all ages	Spring to Fall/ Mid-March to October and mid November
Reproducing-Eggs (RE)	Mating, gestation, egg-laying sites, incubation to hatching.	Spring to Fall/ Mating = May Nesting = July Hatching mid-September
Security/Thermal (ST)	Denning for all ages	Fall, Winter, Early Spring/ October to Mid- March and April

3.1 Growing Season Habitat (LI)

The broadest range of habitat for the racer is living habitat. This habitat is usually associated with grasslands and forest parkland (open canopied forests) within the xeric ecosystems. Living habitat has the broadest range (parkland forests, grasslands and moist areas). Nesting /egg-laying sites are found most frequently in loose sandy soils, under flat rocks, abandoned mammal burrows, talus slopes, on warm slopes with little cover, or in old rotting logs, and are located approximately 500 metres from the hibernaculum (Sarell 2004). This habitat is critical for maintaining populations. Most observed snakes are found within 1 to 1.8 kilometres from their dens (hibernacula), which indicates a limited living and egg-laying range from their hibernacula and dependence upon the habitat associated with the den (Province of British Columbia 1997, as cited in Cascadia Natural Resource Consultants Inc. 2004). Racers radio-tracked in Utah moved a maximum of 1.6 to 1.8 km from two den sites, and the mean home range size of ten non-gravid females was 1.4 ha (Brown and Parker 1976). Racers in Michigan moved up to 2.2 km from den sites (Rosen 1991).

3.2 Hibernation

Dens are usually located in crevices in rock outcrops and talus on warm aspect slopes (Sarell 2004). Suitable features are sufficiently deep to prevent freezing (~3 m, M. Sarell pers. comm.). Deep holes in the sides of south-aspect hills, animal burrows and rock ledges are also used for hibernation by racers (COSEWIC 2004).

3.3 Seasons of Use

Seasonal life requisites are summarized by month in Table 2.

Table 2. Monthly Life Requisites for the Racer.

Month	Southern Interior	Life Requisite

Seasons		
January	Winter	Hibernating
February	Winter	Hibernating
March	Winter	Hibernating/Living
April	Early Spring	Hibernating/Mating/Living
May	Late Spring	Mating/Living
June	Summer	Living/Reproducing-Eggs
July	Summer	Living/Reproducing-Eggs
August	Summer	Living/Reproducing-Eggs
September	Fall	Living/Reproducing-Eggs/Hibernating
October	Fall	Living/Hibernating
November	Winter	Hibernating
December	Winter	Hibernating

3.4 Habitat Use and Ecosystem Attributes

Table 3 outlines how growing habitat relates to specific ecosystem attributes. Structural stage does not appear to be important, but racers using forested habitat appear to prefer open forest with low canopy closure (Sarell 2004).

Table 3. Relationship between Terrestrial Ecosystem Mapping (TEM) attributes and growing habitat for racers.

Growth Stage	TEM attribute
Living	• Structural stages 1-7 • Forest cover includes rock outcrops, talus slopes and an open canopy • BEC zone, site series, structural stage, slope position, aspect, soil

4.0 RATINGS

A 4-class ratings system will be used (Table 4).

Table 4. Habitat Capability and Suitability 4-Class Rating Scheme (from RIC 1999).

% of Provincial Best	Rating	Code
100% - 76%	High	H
75% - 26%	Moderate	M
25% - 1%	Low	L
0%	Nil	N

4.1 Provincial Benchmark

- No benchmark has been identified for the species, however, the BGxh1 and PPxh1 in the SOB may be the provincial benchmark.
- The species occurs within rock outcrops (RO), talus slopes (TA), cultivated fields (CF), big sagebrush shrub/grassland, antelope brush, grasslands, ponderosa pine, wetlands, Douglas fir-ponderosa pine, shrub/grass steppe, trembling aspen copse, bunchgrass grassland, black cottonwood riparian.

4.2 Ratings Assumptions

As racers have not been detected in the Ajax LSA, the maximum rating assigned will be Moderate.

Living

- Structural stages will be rated 1-4 = Moderate, 5-7 = Low.
- A Moderate rating will be given to all grassland, shrub wetlands and open canopy forested habitats.
- All rock outcrops, talus slope habitats will be rated up to M.
- Moist open canopy forests, herb wetlands and cultivated fields in the BG, PP and IDF will be rated up to L.
- Dry to moist closed canopy forests, reclaimed mine and cutbanks will be rated up to L.
- Gravel pit, urban, road, mine, mine tailings and rural will be rated Nil.

The map theme for hibernation should be produced using the terrain rating assumptions below (Table 5), and a separate coverage produced using the ecosystem ratings for comparative purposes. Review of the two coverages will be used to reconcile them into a single theme.

Table 5. Terrain Rating Assumptions for Hibernation

Surficial material		Rating
A	Anthropogenic	Nil
C	Colluvium	up to M
D	Weathered Bedrock	up to M
E	Eolian	up to M
F	Fluvial	up to L for steep (>25%)
FG	Glaciofluvial	up to L for steep (>25%), warm aspect
L	Lacustrine	up to L for steep (>25%), warm aspect
LG	Glaciolacustrine	up to L for steep (>25%), warm aspect
M	Morainal	up to L for steep (>25%), warm aspect
N	None (Lakes, Rivers)	Nil

O	Organic	Nil
R	Bedrock	up to M
Aspect Classes		**Rating**
k	cool	Up to L
w	warm	up to M
Slope Classes		**Rating**
0	0	Nil, except L for surficial materials C and D
1	0-10%	up to L
2	11-25%	up to M for w aspect
3	26-45%	up to M
4	46-70%	up to M
5	>70%	up to M

Assumptions for Hibernation Ratings

1. Warm aspect or ridged rock and talus units in the BG and PP will be rated up to M
2. Gently sloped rock and talus in the BG and PP will be rated up to M.
3. Cool aspect rock and talus in the BG and PP will be rated up to L.
4. Warm aspect or ridged rock and talus in the IDFxh will be rated up to M.
5. Dry forested sites on warm aspects or ridges will be rated up to L. Those on warm aspects or ridges with shallow soils (s or v modifier) will be rated up to M.
6. Mesic to wet forest, wetland, urban, roads, mines, cultivated field, waterbodies will be rated Nil.

4.3 Map Themes and Ratings Adjustments

Living will be modelled using the TEM coverage while hibernating will be modelled using the Terrain coverage. Living habitats must be within 2 km of High or Moderate ratings for Hibernation (HI) habitat in order to be rated higher than Nil. Living will form the backdrop of the map and security/thermal from the terrain model will form the overlay, thereby stressing the hibernating and spring/fall habitat use of the racer. The TEM HI ratings are to be used only as a comparison to the Terrain ST values.

4.4 Confounding Factors and Reliability Qualifier

Moderate Reliability. Available information is based partially on studies, reports and expertise on the species-habitat relationships gained within British Columbia. Some information from ecosystems in the study area has been garnered but largely extrapolated from similar ecosystems. Some verification has been done within the Merritt Forest District and the Ajax LSA.

No racers have been observed in the LSA during fieldwork in 2007- 2008, and 2010 -2014. It is possible that the area's extensive history of resource extraction has depressed local snake populations or racers may never have been present in the area.

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SPECIES – HABITAT MODEL - **Great Basin Gophersnake**

This model was originally prepared for the Nicola-Similkameen Innovative Forest Practices Society (Merritt Forest District), by Crystal Swayze and Mike Sarell. It has been updated and modified for the Ajax Project.

Species data

Common Name: Great Basin Gophersnake, locally known as the Bull Snake

Scientific Name: *Pituophis catenifer deserticola* (Crother et al. 2000), formerly *Pituophis melanoleucus deserticola*

Species Code: R-PICA-DE

BC Status: Blue-listed (BC CDC 2014)

Identified Wildlife Status: Identified (2004)

COSEWIC Status: Threatened (BC CDC 2014)

Project Data

Area: Ajax TEM Mapping Area

Project Map Scale: TEM, 1:20,000

Ecoprovince: Southern Interior

Ecoregion: Thompson-Okanagan Plateau

Ecosection: Thompson Basin (THB)

Biogeoclimatic Zones: BGxh2, BGxw1, PPxh2, IDFxh2

1.0 Distribution

The gophersnake occurs in southern British Columbia and the western United States including Washington, Oregon, Colorado, Nevada, Wyoming, Utah, Arizona and New Mexico (Bertram 2004).

1.2 Provincial Range

In BC, the gophersnake is found in the hot, dry Southern Interior; including the Thompson, and Okanagan valleys, the Fraser Valley from Lillooet to Lytton, west along the Similkameen River almost to Princeton, and near Grand Forks (COSEWIC 2013). The highest population densities occur in the Thompson and Okanagan valleys (Hobbs and Sarell 2000 in Bertram 2004). There is a patchy distribution throughout the dry interior, and snakes are locally abundant at low elevations in the Thompson, Okanogan, and Similkameen Valleys (BC Environment 1997) especially in the Lower Nicola, Lower Similkameen and Coldstream valleys, almost to Cherryville (Sarell 1993).

The gophersnake is classified as "Threatened" due to loss of habitat by agricultural encroachment and urban expansion. Mortality through persecution has been noted, caused by the misidentification with the venomous western rattlesnake (*Crotalus oreganus*) but the greatest source of mortality appears to occur on roadways from vehicular traffic (COSEWIC 2013).

1.3 Elevation range

Elevation range appears to be between 250 m to 1100 m (Bertram 2004). Most of the dens found in Thompson and Okanagan areas were found at 400 to 780 m above sea level and were on a slope (Sarell 1993). One snake was collected at 1580 m (Nelson and Gregory 1992).

1.4 Distribution on the LSA

Gophersnakes were not detected in the study area during field surveys in 2007- 2008 or 2010-2014 and the BC Conservation Data Centre does not have any records of gophersnakes in the area within its database. However, the local residents remember sighting 'bull snakes' in the past, though not recently, and Abacus Mining and Exploration staff reported seeing a small gophersnake near the Ajax pit in 2009. No photographs were taken to confirm its identification. Gophersnakes are assumed to be potentially present at low densities in suitable habitat throughout the study area.

2.0 ECOLOGY AND HABITAT REQUIREMENTS

The Great Basin gophersnake is a sub-species of the *Pituophis catenifer* or gophersnake and related to two other subspecies: *P. c. sayi* (bull snake) and *P.c. catenifer* (Pacific gophersnake). The Great Basin gophersnake is the largest snake in British Columbia, reaching up to 1.8 m in length. The adults in the northwest tend to be smaller than their southern relatives, who may grow to 2.5 m in length. The gophersnake is stocky and powerfully built with a small head. The background colour is yellowish to tan with black, dark brown, or red-brown blotches on the dorsal. The blotches near the front of the body are connected to each other, which distinguishes this subspecies from the Pacific gophersnake. The under body is a cream colour with black or brown spots on the sides of the body. Other distinguishing marks are a horizontal dark line between the eyes, a vertical line running from below the eye to the upper jaw, and an angled stripe running from the eye to the angle of the jaw. The head is slightly wider than the neck and the eyes are relatively large with a round pupil (Gregory and Campbell 1984 in Bertram 2004). The male and female are not significantly different in size, and the young resemble the adults in colour and pattern.

The Great Basin gophersnake is often mistaken for the western rattlesnake not only due to its colour, but because when it is agitated this snake will hiss loudly, flatten its head and vibrate its tail in imitation of the rattlesnake. That behaviour has also contributed to its disappearance as urbanization and agriculture invade its habitat, as it is killed by people that believe it is the venomous look-alike.

Foraging is primarily done at night, especially during the hot summer months. The daytime hours are usually spent underground in vacant rodent burrows. Gophersnakes usually search for food in burrows, under rocks, and in vegetation, though they have been known to climb trees for prey. The Great Basin gophersnake is an opportunistic feeder, preying on nests for eggs and neonate mammals, other smaller snakes, lizards, birds, and small mammals. Their diet is varied and not focused on any single species, although pocket gophers, voles and mice make up the bulk of their diet. Larger mammals such as squirrels, chipmunks and rabbits, as well as birds and sometimes other snakes will also be consumed. Gophersnakes may enter nestboxes to consume eggs and nestlings (Haras 2005). They eat only once a week or less and may consume up to 50 percent of their body weight at a time. The feeding period is about 100 days each year, from late April to early August (COSEWIC 2013), although they may be active until early November.

Males emerge from the dens first before the females, in mid to late April. Mating occurs in May in British Columbia with ovulation in June and oviposition by mid-July (Shewchuk 1997). Incubation lasts from 74 to 76 days with hatchlings appearing in September (Shewchuk 1997). Nests appear to be communal, containing eggs from several females and even other species of snakes such as the racer (*Coluber contrictor mormon)*. There is some evidence that females may not reproduce every year, especially at the outer edges of the species' range (COSEWIC 2013). Shedding occurs soon after the hatchling appears and in British Columbia, annually at the end of July (Shewchuk 1997), although rattlesnakes at the same location shed up to three times a year (Preston 1961).

In British Columbia, the Great Basin gophersnake appears to hibernate between late September to mid-April (Shewchuk 1997). There is little known about what causes these snakes to return to their dens, but it appears to be the length of day and the coldness of nights. However, some males returned to their dens in July, possibly due to the percentage of fat to body weight acting as a stimulus (Shewchuk 1997).

3.0 HABITAT USE – LIFE REQUISITES

Monthly life requisites for the Great Basin gophersnake are summarized in Table 1.

Table 1. Life Requisites for Great Basin gophersnake.

Life requisite	Definition	Season/months
Living (LI)	Foraging, cover and thermoregulation for all ages	Spring to Fall Mid-April to late September
	Breeding, gestation, egg laying	Spring to Fall

Life requisite	Definition	Season/months
	sites, incubation to hatching.	May to mid-September
	Denning for all ages	Fall, Winter, Early Spring late September to Mid-April

The Great Basin gophersnake of British Columbia prefers hot, semi-arid desert, grasslands, shrub steppes, open ponderosa pine and Douglas-fir forests, talus slopes and sandy terraces with antelope brush, cheatgrass, knapweed, and prickly-pear cactus. They will also include some wetland environment within their range and will inhabit brush adjacent to riparian areas (BC Environment 1996). The gophersnake is also attracted to farmlands and cultivated fields for foraging.

Home range size in BC is unknown. The 95% home ranges of four male gophersnakes in California ranged from 0.89-1.78 ha (Rodríguez-Robles 2003).

Preference is given to southern or eastern exposures for denning sites (Nelson and Gregory 1992). Dens may be found within rock outcrops or talus slopes, or south-facing rocky slopes with deep fissures (Shewchuk and Waye 1995; Hobbs and Sarell 2000; Bertram and Larsen 2001). Dens have been found in the Bunchgrass, Ponderosa Pine and the very hot and dry Interior Douglas-fir biogeoclimatic zones (Sarell 1993; Hobbs and Sarell 2000; Bertram and Larsen 2001). The average elevation of dens is 450 m asl (Shewchuk 1996; Bertram and Larsen 2001). The Great Basin gophersnake shows high to moderate fidelity to den sites and often will return to a single denning location throughout its life (COSEWIC 2013).

Egg-laying sites tend to be on south-facing slopes, often in abandoned rodent burrows (Shewchuk 1996; Bertram 2004). The sites seem to be chosen for their thermal and moisture characteristics, generally in loose, sandy soils in open vegetation, on sites that are well drained. The nests are approximately 9-10 cm high and 12-17 cm wide with the eggs 34-43 cm down from the surface (Parker and Brown 1980). Specific thermoregulatory criteria seem to be used for the best conditions for embryo development (Shewchuk 1996). Moisture plays a role in that hatchling size seems to be linked with high moisture content within the nest (COSEWIC 2013).

Foraging tends to occur in open grasslands, however, riparian areas within the grasslands appear to be important (Bertram 2004). Foraging also occurs in open forested areas and cultivated fields. Rock outcrops and wildlife trees (class 8 and 9[dead fallen]) were seen to be important sources of cover for these snakes during and between foraging.

3.1 Seasons of Use

Monthly life requisites are summarized in Table 2.

Table 2. Monthly life requisites for the Great Basin gophersnake.

Month	Southern Interior Seasons	Growth Stage
January	Winter	Hibernating
February	Winter	Hibernating
March	Winter	Hibernating
April	Early Spring	Foraging
May	Late Spring	Mating/Foraging
June	Summer	Ovulating/Foraging/Shedding
July	Summer	Nesting/Foraging/Shedding
August	Summer	Incubating/Foraging
September	Fall	Hatching/Hibernating
October	Fall	Hibernating
November	Winter	Hibernating
December	Winter	Hibernating

3.2 Habitat Use and Ecosystem Attributes

Table 3 outlines how growing habitat relates to specific ecosystem attributes (e.g., site series/ecosystem unit, plant species, canopy closure, age structure, slope, aspect, terrain).

Table 3. Relationship between Terrestrial Ecosystem Mapping (TEM) attributes and growing habitat for Great Basin gophersnake.

Life Requisite	TEM attribute
Living	• Structural stage 1 though 7 • Forest cover includes rock outcrops, talus slopes, open forest • BEC zone, site series, structural stage, slope position, aspect, soil

4.0 Ratings

A 4-class ratings system will be used (Table 4).

Table 4. Habitat Capability and Suitability 4-Class Rating Scheme (from RIC 1999).

% of Provincial Best	Rating	Code
100% - 76%	High	H
75% - 26%	Moderate	M
25% - 1%	Low	L
0%	Nil	N

Ratings will be made for Living in all seasons, which will include habitats used for hibernation, egg-laying and living (habitats used for foraging, cover, and thermoregulation).

The broadest range of habitat for the gophersnake is living habitat. This habitat is usually associated with grasslands and open forest within the xeric ecosystems. Limits to this layer are food sources, water, and cover; however, the living habitat has the broadest range (open forests, grasslands and moist areas) (MWLAP 1997).

Nesting sites have not been observed in the study area, but have elsewhere in BC (e.g. Shewchuk 1996). Egg-laying sites are found most frequently in loose soils on warm slopes and may be used for denning as well. Denning also occurs on cool sites (Betram and Larson 2002). Denning sites and hibernacula have been documented on exposed bedrock or colluvium. This habitat is critical for maintaining populations. Most observed snakes are found within 1 to 2 kilometres from their dens (hibernacula), thus indicating a limited living and egg-laying range from their hibernacula and the dependence upon the habitat associated with the den (MWLAP 1997).

4.1 Provincial Benchmark

The provincial benchmark for the gophersnake has not been identified but probably is in the South Okanogan Basin (SOB) in the very hot and dry Bunchgrass (BGxh1) biogeoclimatic zone. Other BG zones and the PPxh, dh and IDFxh1 are also prime areas.

4.2 Ratings Assumptions

As gophersnake have not been detected in the Ajax LSA, the maximum rating assigned will be Moderate.

- Ratings up to Moderate will be given in the BGxh, BGxw, IDFxh2, and PPxh2 (Bertram 2004).
- Habitats rated highest (expected to provide the best habitat) are: rock outcrops, talus slopes, cultivated fields, cliffs, big sagebrush shrub/grasslands, ponderosa pine and Douglas fir-ponderosa pine forest, ponderosa pine shrub/grass steppe, trembling aspen copse, bunchgrass grassland, black cottonwood riparian. Structural stage does not have an affect on suitability.
- Habitats rated lowest are: reclaimed mine (RY), urban (UR), marsh, lakes, wetlands.
- Rock formations and outcrops are rated highest for this species, as are talus slopes for denning and nesting. Waterbodies are rated Nil as generally just the shorelines are used. Urban settings and cultivated fields are often used for foraging but often act as population sinks. Forested areas can be used for all life requisites, although open areas are generally preferred. Assumptions are summarized in Table 4.

Table 4. Summary of ratings assumptions for Great Basin gophersnake in the RSA.

Attribute	Value	Maximum Rating
Subzone	all	M
Ecosystem Unit	Rock, talus, cultivated field, big sagebrush shrub/grasslands, trembling aspen copse, open ponderosa pine-Douglas-fir forest, black cottonwood riparian.	M
	reclaimed mine, wetlands, cutbank	L
	Closed forest	M
	Mine, mine tailings, waterbodies, gravel pit, road, exposed soil	N
Structural stage	No effect	

4.3 Adjustments

No adjustments have been specified.

4.4 Confounding Factors and Reliability Qualifier

Moderate Reliability. Available information is based mainly on studies, reports and expertise on the species-habitat relationships gained within British Columbia. Some information is gleaned from ecosystems in the LSA, but mostly extrapolated from similar ecosystems. Limited verification has been done within the Merritt Forest District and within the Ajax LSA.

No gophersnakes were detected in the LSA during field surveys, but local residents report the presence of 'bull snakes' in the past. The lack of gophersnake detections within the study area may have resulted from the area's long history of resource extraction, which has depressed local snake populations. Field ratings for hibernating habitat suitability were given up to High, and ratings for living habitat suitability up to Moderately High.

"Habitat suitability values reflect the current productivity of the site and capability values reflect the potential productivity of the site and do not infer that lower values are not important for the species' population dynamics and distribution. This is especially true of hibernacula. If few or only poor hibernacula sites are available those present may be used extensively. The same may be true of egg-laying sites." (MWLAP 1997).

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